POWER

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ELY C. HUTCHINSON, *Editor*

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The Mosaic of the Mind

LIFE is a mosaic of trifles. One's instantaneous mental condition is induced by inconsequential things.

Exaltation and self-satisfaction may result from a good stroke at golf as well as from a successful business transaction or a political success.

A happy encounter with a good-natured friend will fill one with pleasurable impressions. Forced association with a sulk will spread a pall of gloom however little one may be to blame for his companion's ill-humor.

A word of appreciation and encouragement will lighten the day of the recipient and urge to new and light-hearted endeavor. A slight, unintentional though it be, may mean cloudy hours in the life of its subject.

The capacity of the mind to respond to pleasant and unpleasant influences is limited. The continuing effect of overpowering joys and crushing calamities may be of less moment to one's mental serenity than the host of pleasant recollections or regrets called up by momentary sights, sounds and incidents.

The consciousness of having caused pain to a loved one will, after all chance for atonement has passed, cause more recurring mental uneasiness than the realization of neglected opportunities for the improvement of one's own condition.

There is mental satisfaction in the accomplishment of even little things out of all proportion to the effort required to do them.

The satisfaction of being able to say "There, that is taken care of" will momentarily outweigh the depressing thought of the many other things that one ought or wants to do.

It is not what one is doing but what he is thinking that determines his happiness, contentment and mental well-being for the moment.

Is it not the part of wisdom to so live that in the passing hours of future consciousness the mind, flitting over the past, may find the least of regrets to light upon, the most of pleasing and happy recollections to contemplate and with which to be content?

EDITORIALS

More Inside Information Needed

OIL-ENGINE development, it must be admitted, has been hindered through lack of data on combustion and instruments for registering cylinder events.

The designers of steam engines and turbines have at their elbows tables that cover the properties of steam, so that the pressure drops, heat contents, and efficiencies can be accurately computed before the design leaves the drawing board. This has been brought about through willingness of the physicist to devote his time, and industry its money, to the necessary research work.

On the other hand, what tools are offered the designer of internal-combustion engines? Nowhere can be found aids comparable to the steam tables.

Though the oil-engine designer is dealing with a medium of complex structure, the instruments he must use for revealing the behavior of the gases are those of fifty years ago. He has, to be sure, the oscilloscope for observing movements, and the spectroscope for flames, but their value depends largely upon personal powers of interpretation.

Years of labor have been spent on combustion in laboratory bombs and test tubes, but what do we know of the actual behavior of a fuel within engine cylinders? What do we know of compression-ignition, its limitations and specific characteristics? Yet it has been employed for thousands of years by Asiatics in lighting a flame in bamboo plunger igniters. For that matter what does the exhaust pyrometer tell us, and what does the indicator diagram reveal? Just what a baseball scorecard reveals—*results*.

But the desirable thing to know is what happens to produce those results.

Has internal-combustion science no one to do for it the thing Watt did for the steam engine? Cannot the engineer join with the physicist to evolve a device that will interpret and verify combustion procedure within an engine cylinder? Something that goes into the causes of the observed effects.

Could not some application be made of photo-electric cells and the light intensities of combustion? If a measure of pressure has for so long meant a measure of available work, cannot we be provided with something electrically recorded that, for one thing, shall register how nearly prevailing instantaneous changes within the cylinder compare with the conditions in a cylinder with proved high efficiency of combustion? The situation offers a wide field for imagination and creative effort.

Chiefly Politics

A RECENT REPORT of the United States Geological Survey gives the increase in this country's installed water-power capacity in 1929 as 236,248 horsepower. This is less than one-fifth the capacity put into operation in 1928 and is the smallest increase for many years. The 1929 figure does not, however, indicate the true condition in the water-power field, for there are eight hundred thousand horsepower scheduled to go into service during this year. If this program is met it will be fairly comparable with the 1928 figure of slightly over one and one-quarter million horsepower.

The annual increment of installed water power has always fluctuated widely. New steam-plant capacity is subject to the same condition although to a lesser degree. There is unquestionably a slowing up in water-power developments, particularly in some plants of the country. The causes usually cited for this are that the cheap water powers have already been developed, that improvements in steam plants and cheap fuel have taken first place. There is another reason, politics. Consider the Colorado, St. Lawrence and Tennessee Rivers. Developments of water power on these and other rivers have for years been a political football.

International, Federal and state rights have been and are still involved. Even when Federal authority decided upon a policy, state legislatures have failed to do so. The reverse is also true. Scenery protectionists have also contributed to slowing up water-power development, as evidenced in Kentucky, where one of the largest hydro projects in that state has been legislated into a park site. Other states place extraordinary taxes on hydro-electric

power. These and other causes have, taking the country as a whole, had a greater effect in slowing up water-power developments than improvements in steam-plant design and cheap fuel. Unfortunately, the future is not encouraging so far as the political situation is concerned. The prospect is even worse. Like the rivers, water-power politics seem to flow on forever.

Cavitation Research

FOR many years cavitation of hydraulic turbine runners has been a prime worry to numerous designers and operators of hydro power machinery. Explanations of the phenomenon are as varied as they are plentiful, yet cavitation goes merrily on. Most discussions are based on factors in the problem which refer to particular cases. Thus, gradually an historic knowledge is being built up and something must eventually come of it.

It is an unfortunate fact that the causes of cavitation are so numerous and their combination so varied as to baffle universal corrective measures.

The fundamental character of the subject makes it peculiarly suitable for study by the National Hydraulic Laboratory about to be authorized by Congress.

Hydro power users will also hail with satisfaction news that at least two cavitation experimental laboratories, one by a manufacturer and one by an operating company, are under construction in this country.

These institutions will make it possible to conduct cavitation tests on specific runner designs under conditions homologous to the actual, and in some cases the actual head under which the completed plant will operate can be used to test the experimental designs.

These evidences of progressive interest and enterprise will add much to the meager knowledge of cavitation and cannot be too highly commended.

Every Plant Is a Laboratory

EVERY power plant is a laboratory in which the value of various machines and methods may be determined under actual operating conditions. But too often the plant operator fails to follow the first rule of successful laboratory management. "Record the data."

No qualified experimentalist would dream of disregarding this rule. Yet more often than not information obtained in power plants at a cost of hundreds, even thousands, of dollars becomes merely a nebulous addition to the "experience" of the operator. The true significance of a given experience may completely elude understanding if the facts developed are not set down on paper for study and comparison. Even where they are properly interpreted at the time, memory soon grows dim and the fine points slip away one by one. Write them down and stop this waste.

Matters calling for planned investigation in the power plant are many. Take a few examples: What is the best percentage of CO_2 to carry? Each plant must find out for itself—there is no general rule. With given boiler, fuel, firing equipment, setting construction, and type of refractory there will be a certain percentage of CO_2 beyond which the saving in sensible heat in the flue gas will be overbalanced by additional losses in unburned gases and in furnace maintenance. The answer can be found by operating the boilers under various conditions, maintaining close control and keeping careful records. Result: one less item of plant operation left to money-wasting guesswork.

Which refractory is best? Periodic relining of furnaces gives the opportunity for fair comparative tests when the same operating conditions are maintained. But the records must be complete and include all factors.

Fuel selection is another basic problem. How far can one go in the use of cheaper fuel before reduced efficiency and capacity plus other losses will balance the saving in heat cost? Tests—with adequate records, carefully analyzed—will show and give a true guide for future operation.

How can the advantages of instrument control be determined? Try covering the instrument faces on one of two boilers identically equipped and operating under similar conditions. Compare the results after a week or a month and see what return the instruments yield on the investment.

Other elements of boiler room operation, such as frequency and amount of blowdown, frequency of scale cleaning and soot blowing, may be profitably analyzed through tests.

In the turbine room operating tests will determine the best balance between the power consumption of circulating pumps and the fuel saving by higher vacuum. Everywhere in the plant maintenance methods and schedules can be tested through comparative records of maintenance costs.

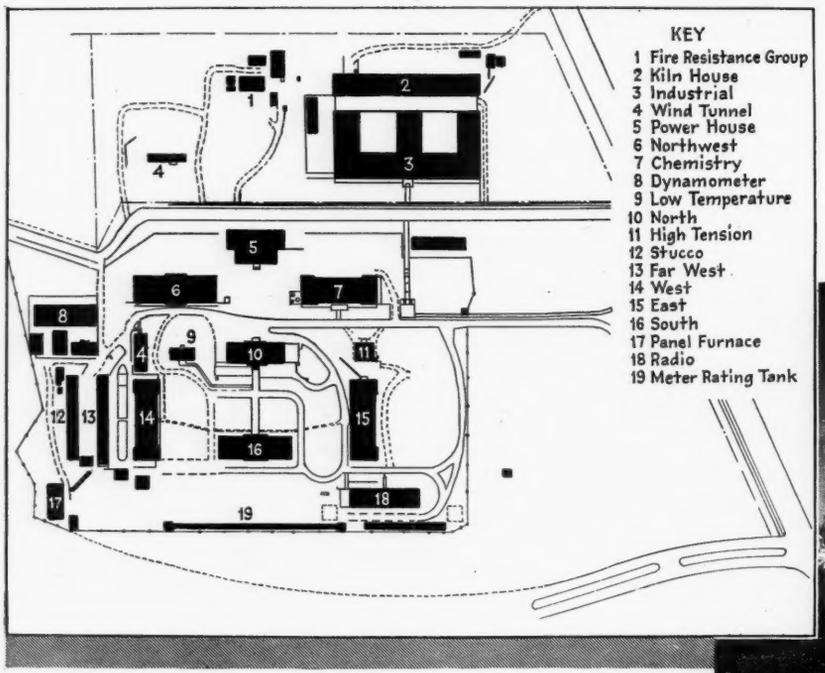
These are but a few examples. Obviously, there are many important things to be learned in every plant. Why not list them, proceed systematically to record the necessary data and thereby accumulate a fund of *facts* as the basis for money-saving operation.

▼

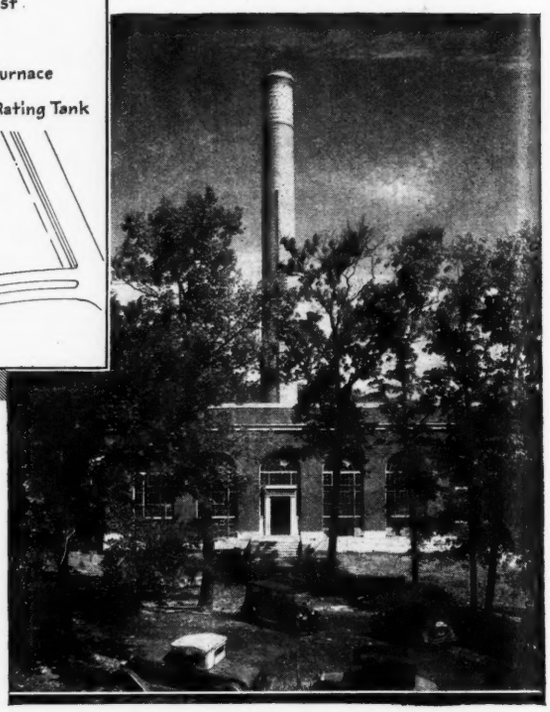
POWER *Stands for . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

▼



Relation of power plant site to other Bureau buildings



The plant is hidden among the trees

BUREAU of STANDARDS' New POWER PLANT

By O. L. BRITT
Supt. of Mechanical Plant

THE new power plant of the Bureau of Standards, Washington, D. C., just completed, is an outstanding example of how, with proper forethought by the designing engineers, a power plant can be divested of all that would make it discordant with its surroundings.

Inasmuch as the Bureau is located in a high-class residental section of the city of Washington, every effort was made in the design of the building to secure one that was good from an architectural viewpoint. This required the elimination of the usual power plant identification features, such as outside coal storage, ash hoppers, hoist towers, coal-receiving hoppers, and protruding exhaust heads. These necessary auxiliaries were housed within, or skillfully concealed by, the building. If it were not for the chimney and spray cooling pond, which obviously could not be concealed, one could not identify the power plant as such from external appearances. The manner in which the building merges into its surroundings can be seen from the above photograph.

The original heating and power plant of the Bureau of Standards was designed to meet the needs of the Bureau when it was first established in its present location in 1903 and occupied a part of one of the two original buildings. As the Bureau has grown during the past 27 years from the two original buildings to eleven major buildings and seven minor buildings, the need for increased plant facilities was keenly felt.

Congress appropriated funds for the construction of the heating and power plant building in 1927, and construction work on the building was started in October of that year and finished in May the following year. Appropriations for equipment were made in 1927, 1928 and 1929.

The boiler room section of the plant was put in operation in August of last year. The engine room equipment is being installed at present and will be in operation shortly.

The location of the plant with respect to the other Bureau buildings is shown on the grounds plan. This

site was selected so as to be nearly central with the group of buildings as finally developed, and occupies land not well adapted for the laboratory type of building.

It will be noted in the cross-section that the coal-receiving hopper is in a small room at the end of the building and is accessible to coal trucks through a large doorway which is equipped with a rolling metal-slat door. As no railroad sidings are accessible, all coal is delivered by dump-body trucks. The ash bin is located within the building directly above the coal-receiving hopper.

Space for a switch room is provided over a part of the boiler room. This arrangement permits of the installation of the switchboard flush with the wall, obviating the necessity of placing the apparatus in the engine room proper. This feature adds much to the neatness of the engine room. The storage battery room is shown directly back of the switch room.

The coal-handling equipment consists of a pivoted-bucket conveyor which receives coal through a reciprocating feeder located at the bottom of the receiving hopper, elevates the coal to the height of the bunker and distributes it to any part of the bunker desired by a movable tripper.

Of the suspended steel-plate type, the bunker has a capacity of approximately 400 tons. No outside storage is provided, as the bunker has sufficient capacity to carry the plant over any period of delay in coal delivery that may occur as a result of weather conditions or breakdown of transportation facilities. There is no coal crusher; an ample supply of screenings which requires no pre-crushing will be available at all times.

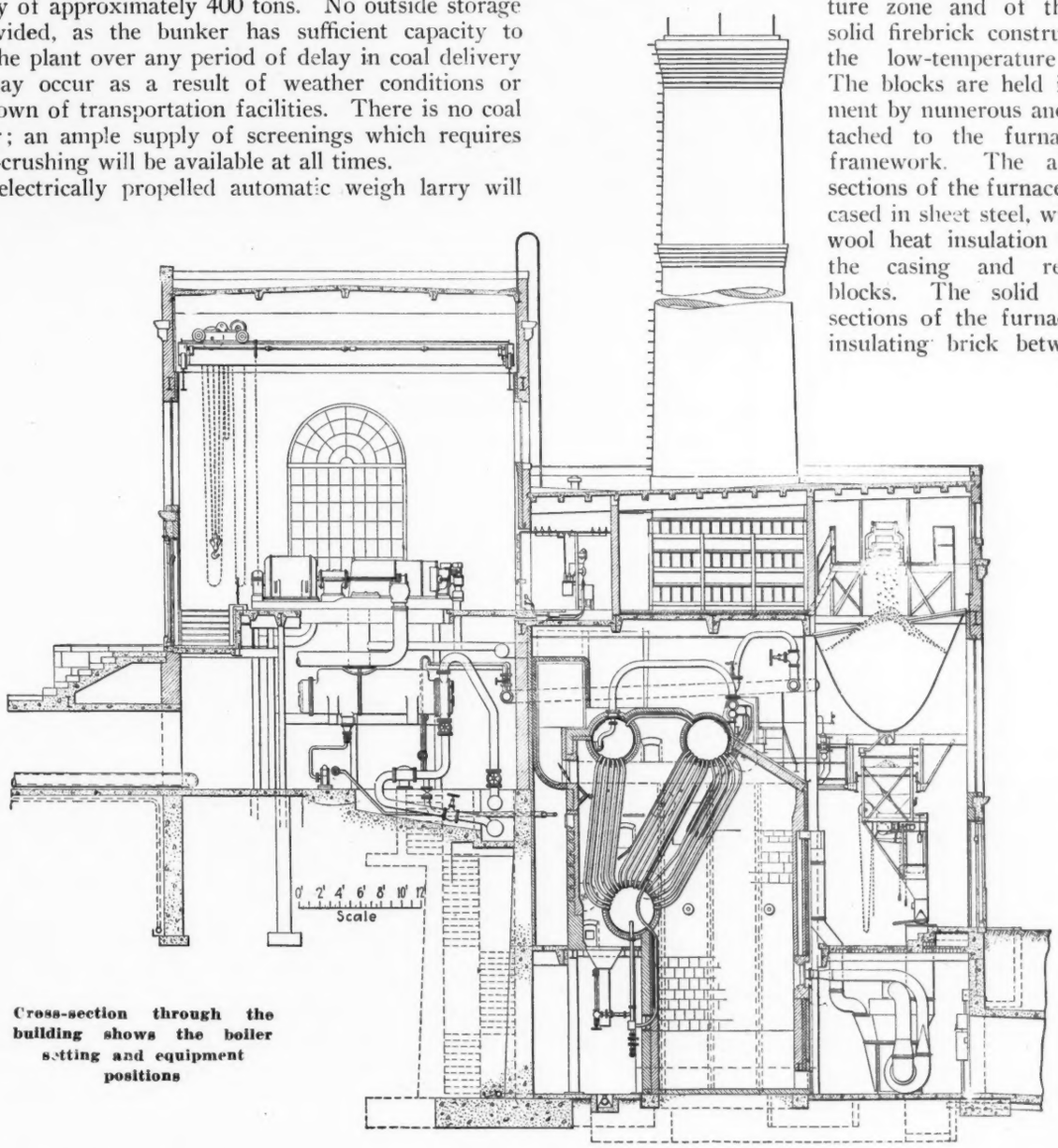
An electrically propelled automatic weigh larry will take coal from any section of the bunker and deliver it to any pulverizer floor hopper. The larry hopper has a capacity of approximately 2,000 lb. and is provided with a 400-lb. automatic scale.

The pulverizer coal-hoppers, located on the operating floor directly above the pulverizers, have sufficient capacity to supply the pulverizers for about one hour under maximum-demand conditions.

Ashes are removed by a 6-inch steam-jet conveyor located back of the boilers. They are shoveled out of the furnaces by hand and then shoveled into the conveyor and delivered to the ash bunker. The latter is constructed of cast-iron plate and is completely closed, except for a vent pipe carried through the roof of the building.

Four 200-lb. pressure boilers, two 5,000-sq.ft. and two 3,400-sq.ft. units, are installed. The larger boilers are of the three-drum, bent-tube design, set in battery, and the smaller boilers, which have longitudinal drums and straight tubes, are set singly. All boilers are equipped with soot blowers and superheaters. The latter are designed to give 100 deg. F. superheat at 200 per cent boiler rating.

All furnaces are of air-cooled refractory-block construction in the high-temperature zone and of the usual solid firebrick construction in the low-temperature zones. The blocks are held in alignment by numerous anchors attached to the furnace steel framework. The air-cooled sections of the furnaces are incased in sheet steel, with rock-wool heat insulation between the casing and refractory blocks. The solid masonry sections of the furnaces have insulating brick between the



Cross-section through the building shows the boiler setting and equipment positions

inner course of firebrick and the outer course of common brick.

The larger furnaces have a volume of 3,500 cu.ft., and the smaller furnaces have a volume of 2,435 cu.ft. each. This gives a heat release of 11,800 B.t.u. per minute per cubic foot of furnace volume in each case when the boilers are operated at 200 per cent rating. Due to this comparatively low heat release no trouble should be experienced with the all-refractory furnace wall. But in the larger furnaces an 8x11-ft. water-cooled section was installed on each of the rear, or bridge, walls to protect against flame impingement when operated at high ratings.

Each furnace is fired with a unit pulverizer. The larger machines have a capacity of 3,500 lb. of coal per hour, and the smaller ones have a capacity of 2,000 lb. Each mill is direct connected to a 1,750-r.p.m. induction motor. No cross connection of pulverized-fuel piping between the various mills and furnaces is employed, as the reliability of the pulverizers is thought to warrant the omission. Preheated air for the pulverizers is taken from the air-cooled walls of the furnace without the use of auxiliary blowers.

One radial-brick chimney 200 ft. high x 10 ft. inside diameter at the top handles the gases from the four boilers.

Rate of combustion necessary to maintain a constant steam pressure is automatically controlled. A mercury float chamber connected to the steam main operates a master regulator which, in turn, operates secondary regulators, one of the latter being located at each pulverizer. The secondary regulator is connected directly to the pulverizer coal-feed mechanism and air-control damper, and operates to increase or decrease the rate of combustion as the steam pressure in the main decreases or increases. The ratio of fuel to air is established manually and is thereafter maintained automatically by the regulator.

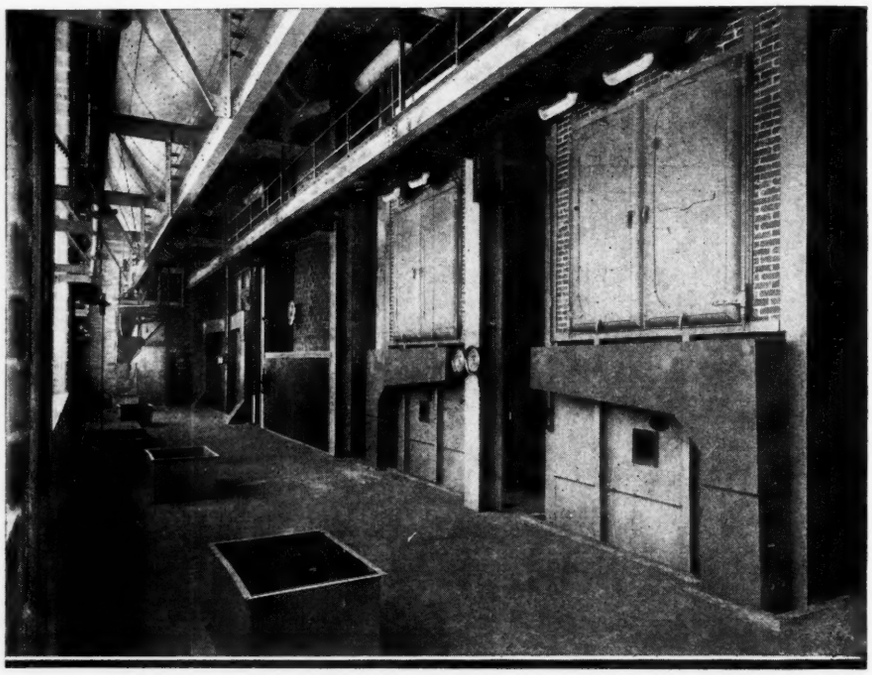
A furnace pressure regulator which operates independently of the combustion-control master regulator is installed on each furnace to maintain the proper furnace pressure by regulation of the damper.

As the water supply cannot be used without treatment, a single-unit zeolite water softener with a capacity of 25,000 gal. in eight hours is provided. The plant's operating schedule is such that there is ample time to regenerate the zeolite when the boilers are not in operation. Space was left in the heater room for the installation of a second water-softening unit should it be found necessary as a result of a change in the operating schedule.

The feet-water heater is of the open type and uses exhaust steam from the station auxiliaries to heat the water. Boiler-feed water is supplied by two turbine-driven pumps having capacities of 150 and 300 gal. per minute. These pumps are located on the boiler room basement floor level, directly under the feed-water heater, thus giving a positive head of approximately 13 ft. on the pump inlet.

The boiler room instruments consist of CO_2 recorders, pyrometers, steam-flow meters, recording pressure gages, draft gages and a clock. The CO_2 and steam-flow meters are electrically operated. All clocks used in the plant are synchronous motor driven.

All feed-water, blowdown and steam piping is gas welded. Wrought-iron extra-heavy pipe was chosen for the water lines, and standard-weight steel pipe for the steam lines. No fittings of any description were used, and flanged connections were installed only where it was necessary to insert valves and orifice plates. Where cast-steel elbows are required ordinarily welded-in tube turns were employed instead. Welded connections greatly reduced the weight of the piping and simplified the installation of the pipe covering.



The boiler room floor is devoid of all firing equipment

The main generating unit consists of a 750-kw., 2,300-volt, 3-phase, 60-cycle turbine-generator. It is of the automatic extraction type and supplies extracted steam at 10 lb. gage for heating purposes.

Only one generating unit is installed at present, as connection with the local public utility company will be retained to supply the night, Sunday and holiday electric services and stand-by service in case of breakdown of the plant's equipment.

Two sources of power supply are very desirable, because of the nature of the work carried on at the Bureau. Many of the investigations in connection with research projects are of long duration, and a failure of the power supply for a short period might cause the loss of much time and valuable material.

The principal direct-current supply at 110-120 volts is taken from a 500-kw. synchronous converter, which, in turn, draws from either the Bureau's turbine-generator or the power company's bus.

A 1,250-sq.ft. surface condenser to operate at 27.5 in. of vacuum is installed in connection with the main turbine. The circulating water pump is turbine driven,

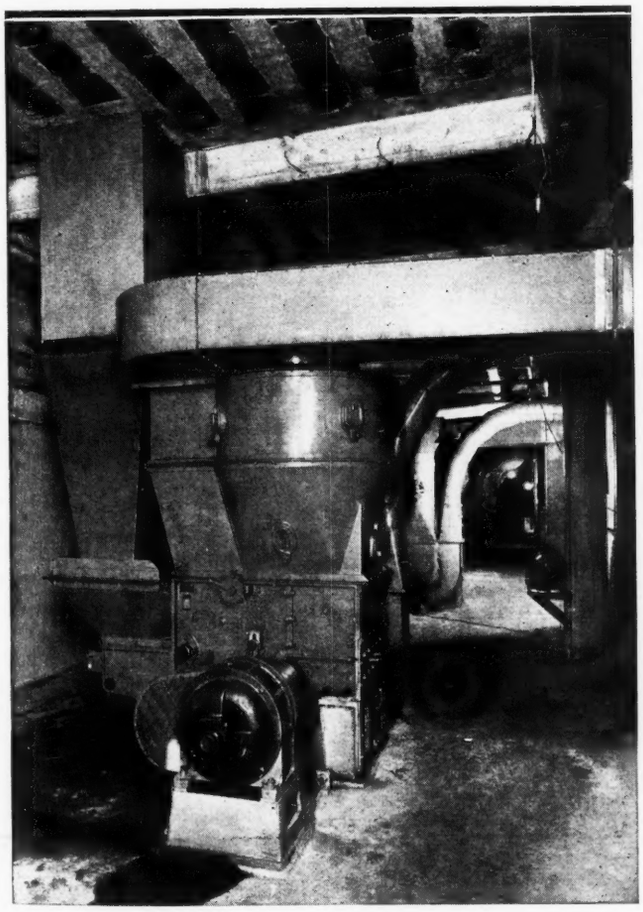
and a motor-driven pump returns the condensate to the feed-water heater. One single-stage steam-jet pump is provided to remove air and non-condensible vapors from the condenser.

As a water-cooling system is necessary in conjunction with the plant condensing system, a spray pond was selected instead of cooling towers, as the former lends itself to artistic treatment more readily than the latter.

All generator and feeder panels are set flush with the engine-room wall and form one side of the switch room. All buses, oil switches and switch-operating mechanism are located in the switch room.

Two 3-phase, 2,300-volt buses are provided, one for the Bureau's generator and one for the power company's incoming supply. Switching arrangements are such that the buses may be operated separately or in parallel, and any feeder may be switched from one source of supply to the other at the will of the operator. Power is taken from the power company's 13,200-volt transmission line and stepped down to 2,300 volts through three 250-kw. transformers located outside of the building.

Storage batteries are provided to meet the requirements for extremely constant potential and current required in many types of tests and research work. The batteries range in size from 5 to 55 amp. at an eight-hour discharge rate. Sixty cells, giving a terminal potential of approximately 120 volts, are provided in all cases, with inter-cell taps for lower voltages where required. The battery room has sufficient space for approximately thirty complete 60-cell batteries. All battery terminals are brought out to a plug-type board, where they may be connected to any one of the many trunk lines leading to the various laboratories. A refrigerating plant will be installed in the engine room basement at some future date to supply refrigeration to the various laboratories requiring this service. It is proposed to use the CO_2 system of cooling in two stages of compression. This system is proposed because much of the experimental work requires temperatures below those obtainable with the ammonia system, and because the transmission piping system is comparatively simple and involves no great personal or property hazards.



The coal pulverizers are located in the boiler room basement

Principal Equipment
Bureau of Standards Power Plant

Boiler Equipment

Boilers, two, 5,000-sq.ft., three-drum bent-tube water-tube ..... Henry Vogt Machine Co.
Two 3,400-sq.ft., horizontal water-tube units..... Babcock & Wilcox Co.
Water walls, two Walsh & Weidner cast-armored-tube ..... Intl. Comb. Eng. Corp.
Furnaces, air-cooled refractory blocks. Furnace Economy Co.
Superheaters, four, to give 100 deg. Superheat at 200 per cent boiler rating..... The Superheater Co.
Feed-water regulators, four, Copes type... Northern Equipment Co.
Soot blowers, eighteen, valve-in head type.... Bayer Co.
Coal pulverizers, two 3,500-lb. and two 2,500-lb. unit mills ..... Strong-Scott Mfg. Co.
Stack, one, 200 ft. x 10 ft. radial brick.. M. W. Kellogg Co.
Breeching, steel, bellows type..... Connery & Co.
Combustion Control..... Carrick Engineering Co.

Coal- and ash-handling equipment

Coal bunker, one, 400-ton plate steel.... Wilbur G. Hudson Corp.
Coal conveyor, one, Peck carrier with pivoted buckets ..... Link-Belt Co.
Coal Scale, one, 400-lb. automatic... Richardson Scale Co.
Ash conveyor, one, 6-in. cast iron pipe steam-jet type ..... Frederick Iron & Steel Co.

Feed-Water Equipment

Feed pumps, one 150-gal. and one 300-gal. turbine-driven centrifugal..... Moore Steam Turbine Corp.
Heater, one, 110,000-lb. per hr. deäerating metering type ..... Cochrane Corp.
Water softener, one, 25,000-gal., zeolite type.. Permutit Co.

Turbine Equipment

Turbine, one, extraction-type direct connected to 750 kw. Allis-Chalmers 3-phase, 60-cycle, 2,300 volt generator ..... Murray Iron Works Co.
Exciter, one, 12-kw., motor driven.... Westinghouse Elec. & Mfg. Co.
Condenser, one, 1,250-sq.ft. surface..... Elliott Co.
Circulating pump, one, turbine-driven centrifugal.. Dayton-Dowd Co.
Condensate pump, one, motor-driven centrifugal.. Elliott Co.
Air ejector, one, 6.5 cu.ft. per min., steam jet.. Elliott Co.
Spray heads, 56 spray heads and piping..... Spraco Inc.
Switchboard..... Westinghouse Elec. & Mfg. Co.
Piping..... Heat & Power Corp.
Valves ..... Crane Co.
Non-return valves... Golden-Anderson Valve Specialty Co.

Single Calorimetric Apparatus Determines Steam Properties

IN A paper which will be published in the May number of the Bureau of Standards *Journal of Research* a calorimetric method for determining the thermodynamic characteristics of a fluid is outlined. The basic principles involved and the application of the method to formulation of thermal properties for engineering uses are both analyzed. The method has been developed at the bureau for determining the properties of steam.

A single calorimetric apparatus specially designed and with especial refinements provides a setting for a systematic group of experiments of four types in which four characteristic heat quantities are determined, each as a function of temperature.

How OPERATING CONDITIONS Affect Chemical Feed Treatment

By D. C. CARMICHAEL
Industrial Engineering Division
E. I. Du Pont de Nemours & Company

Successful feed-water treatment requires more than chemical knowledge. Operating and mechanical factors must be given consideration, as is shown by practical studies made in two plants, one using a lime soda softener and the other internal treatment

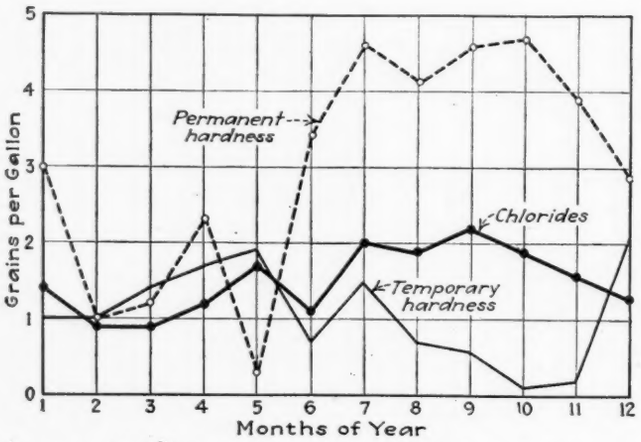


Fig. 1—Chart showing variation of feed water in Plant 1

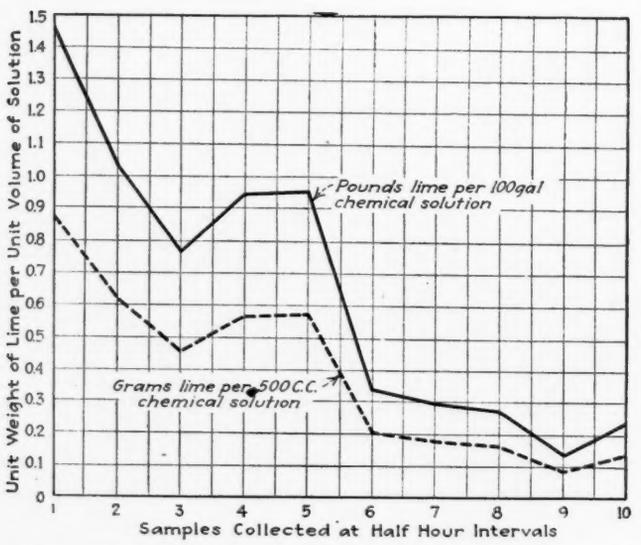


Fig. 2—Chart showing variation of lime treatment, Plant 1

WHEN properly treating a water for boiler-feed purposes other factors than just a chemical analysis of the water have an exceedingly important bearing. While a chemical analysis is part of the necessary data, often a survey of the operating and mechanical conditions combined with the chemical information is partly or altogether overlooked.

Operating data to be collected may be classed as follows: Steam pressure, rating, character of load (whether fluctuating or steady), amount of condensate returns, source of the returns, and temperature of the feed water from the heater or deaërator. In most large generating stations surface condensers are used and the condensate is supplied from that source. In the industrial plant, on the other hand, this may not be the case. Often condensate is returned from heating systems and closed heaters from which more or less contamination is received, depending on whether live or exhaust steam is used and on the type of prime mover.

From a mechanical standpoint, the data should include the type of heater (whether open or closed and of sufficient capacity, if of the open or deaërating type, to heat all the water for boiler-feed purposes to the maximum temperature necessary to drive off the corrosive gases to the atmosphere), and name, number and rated horsepower of each type of boiler and the condensers, whether surface, jet or barometric.

If a softening system is in active operation, complete information as to the type and size of settling tanks should be procured. That this is necessary was shown in an investigation described later. The plant investigated was equipped with an undersized softener for the amount of water treated, and the chemicals necessary to advise were those which would give quick reactions and maximum settling efficiency in a minimum length of time. Information as to the condition of the sand filters, when used in conjunction with the softening system is also required.

Investigations were made in a plant where several of

TABLE I—LABORATORY ANALYSES OF AVERAGE MONTHLY SAMPLES OF BOILER FEED WATER (Plant 1)

(Grains per U. S. Gallon)

Month	Temporary Hardness	Permanent Hardness*	Sodium Chloride
January	1.0	3.0	1.4
February	1.0	1.0	0.9
March	1.4	1.2	0.9
April	1.7	2.3	1.2
May	1.9	0.3	1.7
June	0.7	3.4	1.1
July	1.5	4.6	2.0
August	0.7	4.1	1.9
September	0.6	4.6	2.2
October	0.1	4.7	1.9
November	0.2	3.9	1.6
December	2.1	2.9	1.3

*Expressed in terms of calcium carbonate.

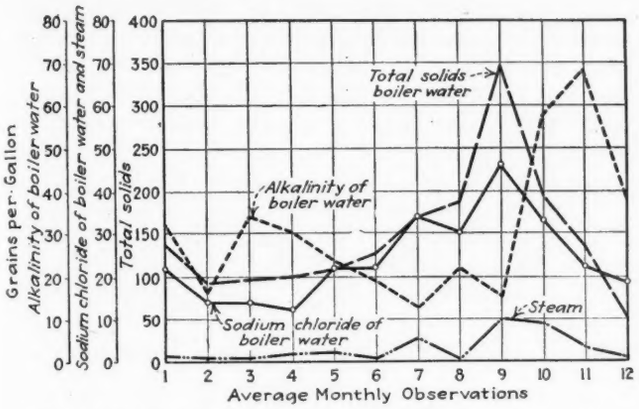


Fig. 3—Showing how failure to blow down properly causes foaming conditions, Plant 1

these factors entered into the proper conditioning of the water, and various reasons with corrective measures were advanced. However, these recommendations did not prove successful, so a detailed investigation was made at the plant. The important factors governing the conditions were found and recommendations submitted for correcting the trouble.

This article covers investigations made in two different plants; one using a hot process softener and the other internal treatment. The boiler-feed supply in each case was river water whose mineral content of soluble salts was about that of the average industrial supply. As mentioned above, the raw or river water in the first plant was passed through a hot-process continuous lime-soda ash softener, filtered and used for boiler-feed purposes.

Considering the first of these plants, Fig. 1 shows the changes of temporary and permanent hardness and chlorides over a period of a year for the raw water (boiler feed). Table I shows the laboratory analyses of the average monthly samples of boiler feed water, and Table II a complete analysis of the raw water. The plant using this water as boiler feed was equipped with a hot-process continuous lime-soda softener, but was experiencing a hard, dense calcium-sulphate scale in the boiler tubes. The analyses of several samples of tube scale are given in Table III.

During the investigation the lime treatment was decreased approximately 25 per cent in the course of a week, with a 10 per cent increase in soda ash, and after a period of four months' supervision on the softener operation all the old scale formations were removed, and there were no indications of any new scale formations after eighteen months' operation.

A condition often overlooked in the operation of a softener is the accurate proportioning of chemicals, especially the milk-of-lime solution. Unless proper agitation in the chemical dissolving tank is obtained, the proportion of lime per unit volume of solution will gradually change as the chemical tank is emptied. This condition occurred in the plant under discussion and was overcome by a change in location and the installation of a new agitator. Fig. 2 shows the effect of improper proportioning of the lime solution. The results were obtained by collecting samples of chemical solution every 30 min. from the discharge of the chemical proportioner. These samples were analyzed for the calcium content which was converted to lime (calcium hydrate).

TABLE II—ANALYSIS OF RAW WATER (Plant 1)

	Grains per Gallon
Silica	0.40
Iron and alumina	0.10
Calcium carbonate	0.90
Magnesium carbonate	Trace
Magnesium chloride	Nil
Sodium chloride	2.80
Sodium sulphate	0.12
Calcium sulphate	4.00
Magnesium sulphate	3.00
Total solids	11.32

Occasional conditions of foaming were experienced when the operators did not blow down the required amount, as is shown in Fig. 3. This condition is plainly pointed out by the increase of permanent hardness during the ninth month, as shown in Fig. 1, and the following increase of total solids, Fig. 3, during the same period. The amount of soda ash treatment per 100,000 gal. of feed water as given in Table IV also shows an increase for the ninth month. During the period of high concentration an average sample of trap discharge from the main steam header contained 9.8 grains per gallon of sodium chloride, thus showing the effect of increased concentration of soluble salts in the boiler water.

In both investigations a chemical method, in place of a throttling calorimeter, was used to determine the quality of steam generated. Trap discharges were collected at various locations, and examined for their content of alkaline sodas and sodium chloride. Thus a trap discharge free of soda and salt would mean 100 per cent dry steam, while those containing these materials indicated contamination in proportion to the percentage of boiler water contained in the trap discharge. Where wet steam in this case was caused by high concentration of soluble salts, the curve of the sodium chloride present in the steam followed the general increase and decrease of the total solids of the boiler water.

TABLE III—ANALYSIS OF TUBE SCALE (Plant 1)

	No. 4 Boiler Per Cent	No. 6 Boiler Per Cent
Silica	2.68	0.40
Iron and alumina	10.24	3.68
Calcium sulphate	53.45	45.33
Calcium and magnesium as calcium carbonate	33.63	50.59

At present this plant (No. 1) is making daily tests on the treated water, boiler water and condensed steam. The water from each boiler is tested for alkaline and chloride salts, so that the concentration of the boiler water is known. Thus proper regulation of blowdown is obtained by the sodium-chloride concentra-

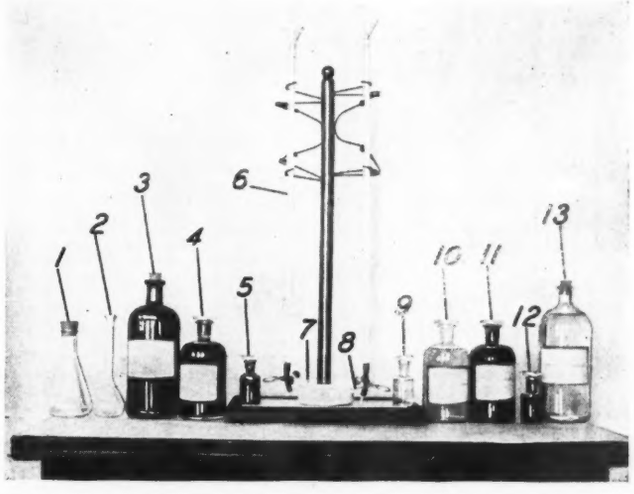


FIG. 4—APPARATUS FOR WATER TESTING

1, sampling flask; 2, 100-c.c. measuring flask; 3, silver nitrate solution; 4, potassium chromate indicator solution; 5, dropper bottle with potassium chromate; 6, burette; 7, porcelain titrating dish; 8, glass stirring rod; 9, dropper bottle with phenolphthalein; 10, phenolphthalein indicator solution; 11, methyl orange solution; 12, dropper bottle, methyl orange; 13, normal twenty-fifth sulphuric acid.

tion. The apparatus used to carry out the various tests is pictured in Fig. 4, and includes two burettes, a white porcelain dish, and the necessary indicators—phenolphthalein (1 gram per liter of alcohol), methyl orange (1 gram per liter of distilled water), and potassium chromate (50 grams per liter of distilled water)—and the titrating agents 1/25 normal sulphuric acid and standard silver nitrate (5 grams per liter of distilled water). These tests are covered in the directions here given.

This investigation shows that a study of operating

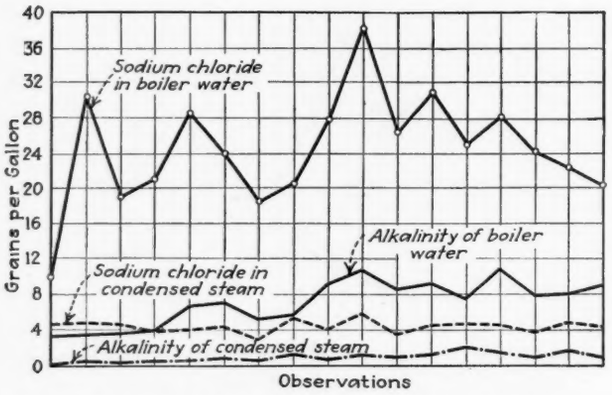


Fig. 5—Effect of oil in feed water on quality of steam (oil present in condensate returns; make-up is pond and city water)

conditions combined with the proper control of the softener brought about a substantial saving in the boiler operations.

Directions for Testing Water Samples:

1. Measure out 100 c.c. of filtered boiler water.

2. Pour into a porcelain dish and add 5 drops of phenolpthalein indicator. This will turn the water pink, because of the presence of soda.

3. Fill the burette to the zero mark with 1/25 normal sulphuric acid, and gradually add (titrate) the acid to the water until the pink color starts to fade. Continue adding until the faint pink color entirely disappears.

4. To the same sample of water add 2 to 5 drops of methyl orange indicator. This will turn the water a lemon yellow color. Titrate with the acid solution, using

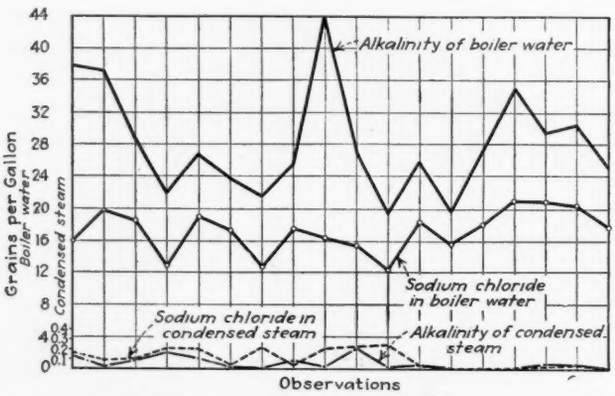


Fig. 6—Chart showing quality of steam, no oil contamination, make-up pond water

the same measure of acid as in Test 3. The end point is shown by the change from yellow to red.

5. To the same sample of water add 5 drops of potassium chromate indicator. This will turn the water yellow.

6. Fill the second burette to the zero mark with standard silver nitrate. Add (titrate) silver nitrate from the burette. Approaching the end point, a red color will appear and then disappear with each addition of silver nitrate. Continue titration until this red color remains permanent, giving the sample a faint brownish-red tinge. This is the end point, and the cubic centimeters of silver nitrate used represents the grains per gallon of salt, when the original sample of water was 100 cubic centimeters.

7. The treated water from the softener and condensed steam from the trap discharge are tested in the same manner as the boiler water. The cubic centimeter of acid used in Tests 3 and 4 when multiplied by 1.16 gives the alkalinity in terms of calcium carbonate.

Tests Made at Plant 2

Another investigation was made in an industrial plant experiencing trouble with foaming and scale conditions. The boiler equipment consisted of eight units, ranging from 2,600 to 4,000 sq.ft. operated at 150 per cent rating. Load conditions were uniform, the steam being used for power and process.

Power was generated by reciprocating engines from which the exhaust steam was used directly for heating in the process work.

The lines carrying the exhaust steam were not equipped with oil separators, so that the condensate re-

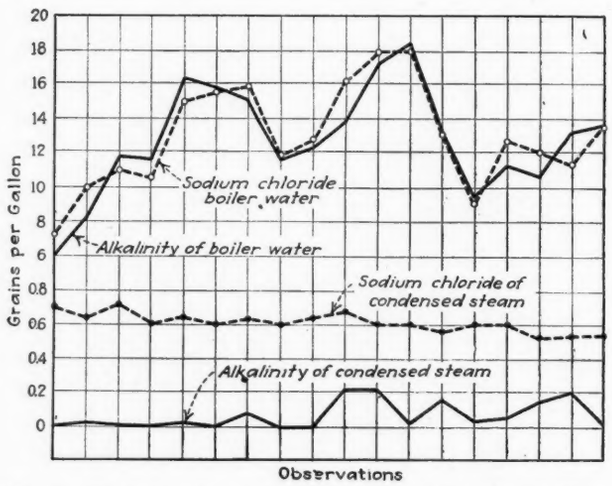


Fig. 7—Chart showing quality of steam, no oil contamination, make-up city water

turns from the heating processes carried considerable amounts of compound oil to the hot well. At this location, the make-up, consisting of pond and city water, was introduced. The returns from traps and steam separators were also fed into the hot well, increasing the contamination in the feed water when soluble material was carried over in the steam from the boilers. The major cause of foaming was the compound oil returned to the hot well. The content of oil was sufficient to show from one to three grains per gallon in samples of feed

TABLE IV—SODA ASH TREATMENT PER 100,000 GALLONS—RAW WATER (Plant 1)

	Lb.
January	76.5
February	97.0
March	100.2
April	66.1
May	77.0
June	94.0
July	144.0
August	157.0
September	184.0
October	140.0
November	125.0
December	99.0

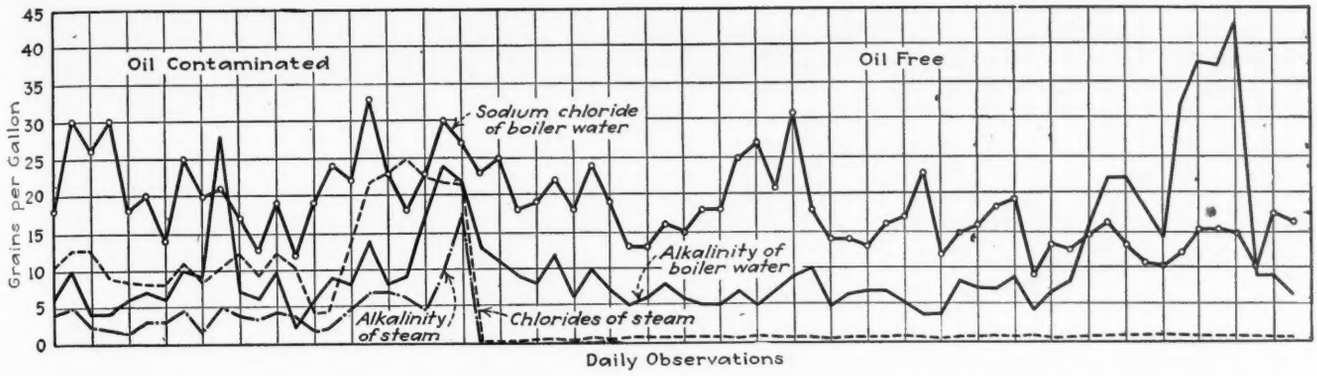


Fig. 8—Effect of oil in feed water on quality of steam

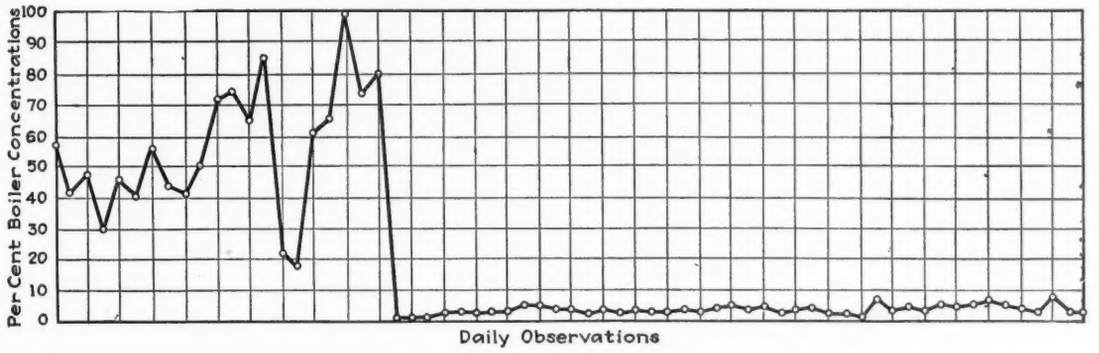


Fig. 9—Soluble solids in condensed steam in per cent boiler concentration

water collected from the discharge of the boiler-feed pump.

Fig. 5 shows the effect of oil on the quality of steam in terms of the soda and sodium chloride carried over from the boiler water. Fatty acids in compound oils react with soda ash in the feed water and form soap, which gives rise to severe foaming.

It has been noted from various observations that when sufficient hardness is present in the boiler water, soap formed by the fatty acids is neutralized, but as soon as the treatment is increased in sufficient quantities to precipitate the hardness foaming will immediately take place.

The question of concentration of soluble solids arose in connection with the foaming, and to show that this did not have any appreciable effect on the condensed steam tests were made on two plants near by, one using city water and the other pond water as make-up. Results of these two tests are shown in Figs. 6 and 7, and indicate that no trouble was being encountered with soluble material being carried over in the steam.

On account of the low soda alkalinity in the boiler water, caused by the foaming, heavy scale was encountered. When the oil contamination was stopped by the installation of a sand filter and alum feeder a higher boiler water alkalinity could be obtained, which was reflected by less scale.

Figs. 8 and 9, while having no bearing on the conditions of Plant 2, show the effect of oil-contaminated and oil-free feed water.

The change in soluble material in the steam took place in a few days, as is shown by the daily tests. A sample of the condensed steam during a severe foaming condition analyzed as follows:

Sodium carbonate, 2.97 grains per gallon; sodium bicarbonate, 2.02 grains per gallon; sodium chloride, 6.30 grains per gallon; sodium sulphate, 15.10 grains per gallon; organic and suspended matter, 13.60 grains per gallon; total solids, 40.00 grains per gallon.

This second investigation shows that it is very necessary to take into consideration the source of all condensate returns, especially in the industrial plant, where more or less contamination is present.

From the tests stated herein, it is evident that the operating and mechanical conditions should be taken into consideration along with the chemical factors bearing on the proper water treatment.

Conclusions

In most plants, the mechanical department handles certain conditions pertaining to the boilers, and the chemical department the analyses and testing of the water. The chemist uses certain terms familiar to him but foreign to the mechanical engineer. The same applies to the terms of the mechanical engineer. Each finds it difficult to understand the other.

If an investigation can be made and all factors taken into consideration, better results can usually be obtained with the water treatment.

Pulverized Fuel Ash Used for Condenser Cleaning

THE condenser circulating water inlet at the East River station of the New York Edison Company is located close to the outlet of one of New York's trunk sewers. Material from this finds its way into the condensers and makes keeping them clean a particularly difficult job.

Various cleaning methods have been tried, including rubber plugs, wire brush, and water and air. None of these proved effective.

Sand blasting cleans the condenser tubes effectively, but it also removes considerable of the tube metal. The amount of metal removed, of course, depends upon how abrasive the sand is, the amount used and the hardness of the condenser tube. Tests in some instances have indicated a 3 per cent loss in weight after 300 quarts of sand had been used.

In looking for something that would have the clean-

ing efficiency of sand, but not its abrasive action it was decided to try pulverized fuel ash and water. The ash alone did not clean as effectively as desired, but when mixed with a small amount of sand the cleaning was almost as satisfactory as with sand alone.

The mixture found best from both points of view was three parts of pulverized fuel ash and one part of sand. One hundred cleaning operations were conducted with this mixture on a condenser tube and it was found that the loss in weight was negligible.

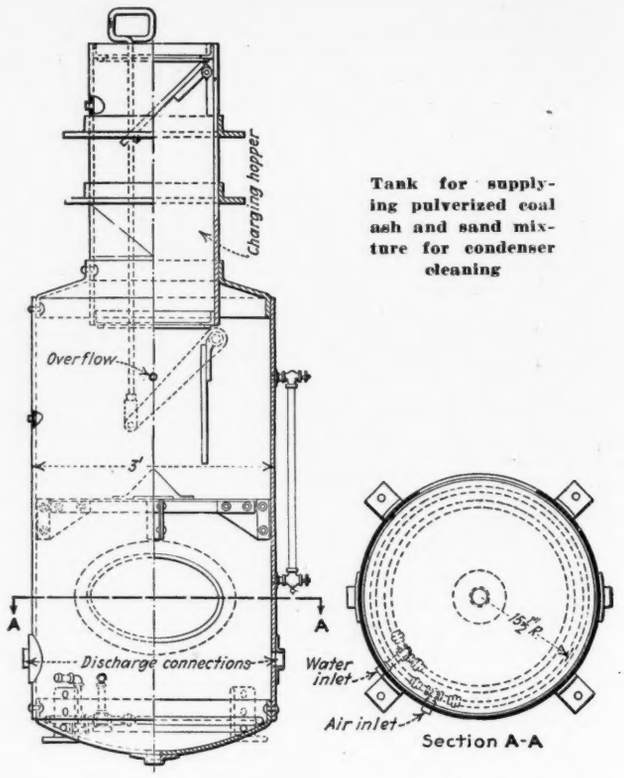
To use this mixture conveniently two tanks each about 3-ft. in diameter and 5-ft. high were installed. One of these serves two condensers, the other serves only one. The top of the tank is fitted with a hopper through which the ash and sand is charged. Three pails of sand and nine pails of ash constitute one charge. The tank is then filled with water to make a thin mixture.

Air at 100 lb. pressure is introduced through a perforated pipe in such a way as to keep the sand and ash mixture stirred up. A flap valve prevents air leaking up through the charging hopper.

At the bottom of the tank there are two connections for one-inch hose. The end of the hose is provided with a nozzle, designed to fit the condenser tubes, and a quick opening valve. The nozzle is held up against the tube and the valve opened for a few seconds, allowing a slug of water, and ash and sand to be shot through the tube.

With this equipment condenser cleaning is both rapid and effective. Three men with two nozzles working for six hours can clean a condenser containing approximately 10,000 tubes. The tank contains enough of the mixture for about a half hour's work with two nozzles in operation.

Operation at the East River station is such that a condenser is seldom available for cleaning for more than three hours, so it is possible to clean only a portion of a condenser during a night's work. The next night cleaning starts where the previous night's work left off, or it may be necessary to work on a different condenser. It results that during a period of about three weeks all three condensers are cleaned completely.



Tank for supplying pulverized coal ash and sand mixture for condenser cleaning

Information for this article was obtained through the courtesy of W. H. Lawrence, chief operating engineer, New York Edison Company, and A. J. Wheeler, superintendent, East River station.

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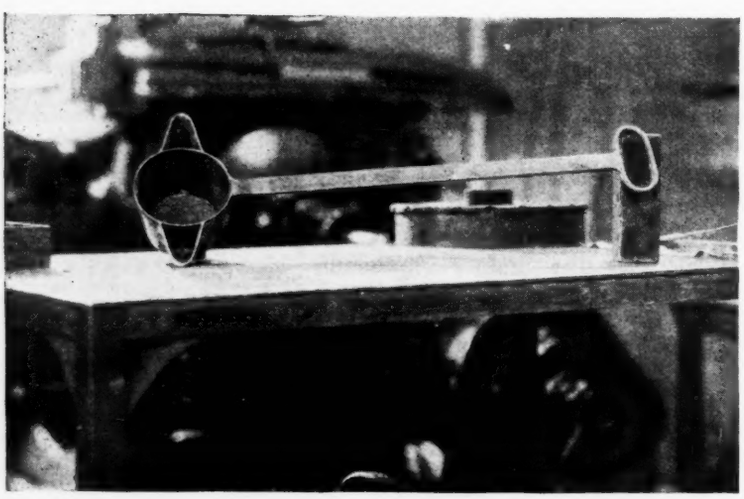
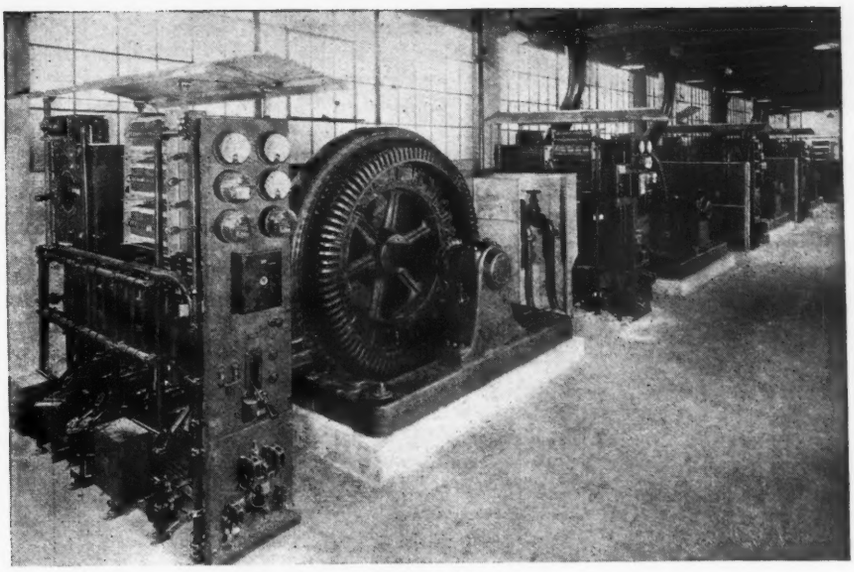
A Welded Babbitt Ladle



THE ACCOMPANYING photograph, supplied by the Linde Air Products Company, shows a babbitt ladle fabricated by the welder of a New York hotel. It has a long handle and two lips with bottom feed so that the molten metal poured is free from slag.

The lips were made of $\frac{1}{8}$-in. steel heated by the blowpipe flame and forged into shape. The body was made by shaping a cylinder from similar steel. Two holes for the bottom pour were cut out by the oxy-acetylene cutting blowpipe, and a bottom plate similarly cut was oxwelded in position. The lips were then welded on as shown. The handle, heated and forged from $\frac{1}{4}$-in. steel, was also welded to the body.

Insulation Resistance



A Guide to the Condition of

Electrical Equipment

One of the best guides to the condition of an electrical machine is its insulation resistance. This article tells the effect of moisture on insulation; how to measure insulation resistance and interpret these values; what constitutes a good value of insulation resistance; and how to restore the qualities of low insulation

By ROBERT BALL
Pittsburgh, Calif.

WATER being a fair conductor, it is not safe to operate electrical equipment having wet insulation. While low-voltage machinery may operate with moist insulation, failure of high-voltage equipment is certain if its insulation contains moisture. Instances can be cited of motors and generators operating under emergency conditions while wet, and of transformers operating with water in their insulating oil, but in such cases sufficient moisture has not penetrated the insulation to form a conducting path. Moisture cannot easily penetrate insulation that is thoroughly impregnated with insulating varnishes or compounds.

The dryness, or resistance, of insulation cannot be determined with any degree of accuracy by examination. It is sometimes assumed that drying is unnecessary unless evidence of rust, or drops of water are visible. A skilled man, after carefully examining a piece of equipment, noting the condition of its crate or container, and knowing its history, can give an opinion as to whether or not drying is necessary. But where equipment of importance is concerned there is generally too much at stake to depend on even an expert's judgment.

Insulation resistance is usually expressed in megohms (millions of ohms). A Megger or a similar device is now the recognized method of measuring insulation resistance. It is portable and reliable, and makes accurate insulation-resistance measurements a simple matter. A lack of appreciation of the value of insulation-resistance measurements has prevented these devices being used as fully as conditions warrant. The Wheatstone bridge and voltmeter methods of measuring insulation resistance have long been in use, but the Megger method is superior.

A direct-current voltmeter of known resistance is required when insulation resistance is to be measured by the voltmeter method. The voltage of the testing circuit is first read, by closing the single-pole switch in the diagram to the down position. Then the voltmeter is connected in series with the insulation by closing the switch to the up position. The insulation resistance can be computed from formula

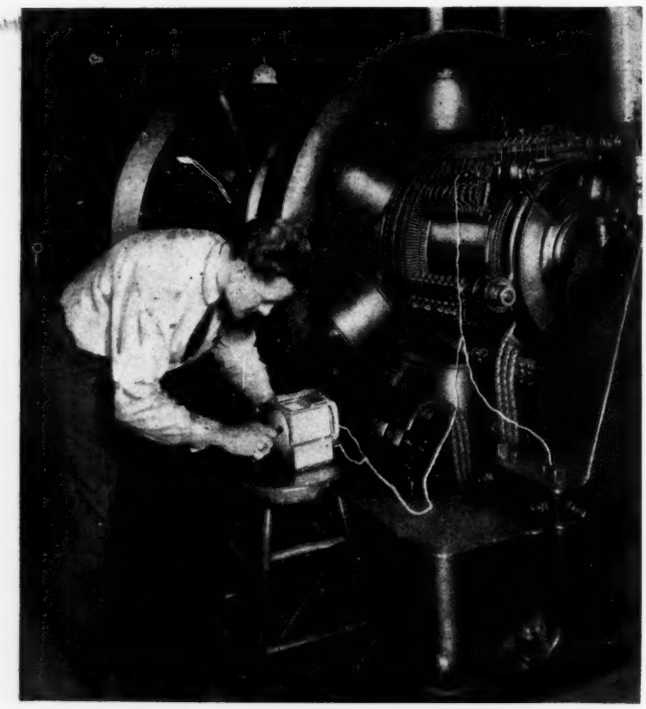
$$R_i = R\left(\frac{E}{E_i} - 1\right)$$

Where E = Voltage of the testing circuit.
E_i = Reading of the voltmeter when in series with insulation.
R = Resistance of the voltmeter.
R_i = Insulation resistance in ohms.

As an example, assume that $E = 250$ volts, $E_i = 20$ volts and $R = 50{,}000$ ohms, then $R_i = 50{,}000 \times \left(\frac{250}{20} - 1\right) = 50{,}000 \times 11.5 = 575{,}000$ ohms.

To determine if drying is necessary each electrically separate winding should have its insulation resistance measured to the frame, and between windings. Assuming that the windings have not been damaged, low readings indicate the necessity of drying. A reading of zero may be obtained if the insulation is wet. Even though high insulation-resistance readings are obtained, they are of little importance unless values determined when the insulation was dry and in good condition are available for comparison. If, after assembly in the factory, the insulation resistance of a generator's stator is 50 megohms, a reading of 45 megohms at the same temperature after installation indicates that but little moisture has been absorbed.

Generally the insulation resistance of new apparatus when dry and in good condition is not readily available, but the manufacturer should be able to supply it. For some unknown reason the insulation resistances of identical machines taken under similar conditions differ widely. According to the standards of the A.I.E.E., min-



Checking insulation resistance with a Megger

imum insulation resistance at operating temperature should be:

$$Megohms = \frac{Terminal\ Volts}{Kva.\ Rating + 1{,}000}$$

For example, a 20,000-kva., 11-kv. generator's insulation resistance should be at least:

$$Megohms = \frac{11{,}000}{(20{,}000 + 1{,}000)} = 0.524, \text{ that is, } 524{,}000 \text{ ohms.}$$

The values obtained from this formula are considerably lower than those usually prevailing for either old or new equipment. The writer believes that the values obtained with this formula should be multiplied by factors ranging from 2 to 10, the higher factors applying to high-voltage equipment.

A simple formula that more nearly agrees with insulation resistances actually obtained is megohms equals the machine's terminal volts divided by 1,000; that is, the insulation resistance of an 11,000-volt generator should be 11,000 ÷ 1,000 = 11 megohms.

It is well known that the voltage necessary to puncture insulation cannot be obtained from insulation-resistance readings alone. Windings are, in general, well insulated provided the insulation is dry, clean and has not deteriorated. The application of a high-potential test is advisable on new machines only, and such testing should be done at the factory. Rarely is a high-voltage test desirable after installation. Such a test should never be applied until after high insulation-resistance readings are obtained.

It is desirable that the temperature of the equipment be recorded when the insulation resistance is measured, since this resistance decreases as the temperature increases. It is also recommended that hot and cold values of insulation resistance be obtained. Unless important equipment has a considerably higher insulation resistance than obtained by applying the A.I.E.E. formula, drying is advisable. New apparatus should not be placed in service unless it has an insulation resistance of one megohm or higher when cold. Whenever possible the drying procedure should be carefully planned in advance, in cooperation with the manufacturer. The drying should be so done as to obtain the required insulation resistance in the minimum time compatible with safety.

The data obtained during a dry-out run should be arranged in the form of an engineering report and filed for future reference. Such a report would be valuable should subsequent drying become necessary, as would be the case in the event of floods, excessive precipitation, broken steam or water pipes, and similar mishaps.

Fire Hazard When Drying

Before drying electrical equipment, provision must be made to prevent fire, and to effectively combat it if started. When fire-extinguishing equipment is part of the machine it should be ready for immediate use before beginning the dry-out run. Portable fire extinguishers, preferably of the carbon-tetrachloride type, should be on hand for instant use, even when only small and relatively unimportant equipment is being dried in an oven.

Only competent men having a well-developed sense of responsibility should be intrusted with drying electrical equipment. Their duties are to keep constant and alert watch over all parts of the equipment; to maintain the prescribed conditions; to accurately record instrument readings and other data; and to prevent damage from overheating, fire, or other causes.

Electrical equipment being dried in a fireproof oven that is automatically maintained at 90 deg. C. or less by thermostat does not require constant attention. But when dried by other methods constant watch should be kept on the equipment because of the damage that will result from excessive temperatures.

Duration of the drying process will depend on the initial insulation resistance, size of the equipment, voltage rating and on the machine's previous history. Low insulation-resistance readings obtained on apparatus that has been exposed to moisture for a long time indicate that considerable drying is necessary. Equipment that has been kept free of moisture and which has high insulation resistance requires little, if any, drying.

During a dry-out run, at constant temperature, the insulation-resistance readings gradually increase (sometimes, however, they will first drop lower than the initial value), and as the insulation becomes dry will either remain constant, or increase very slowly. Drying may be

discontinued when a number of consecutive insulation-resistance readings remain constant, Table I. The constant values must be higher than those obtained from the A.I.E.E. formula.

TABLE I—REQUIRED INSULATION-RESISTANCE READINGS

Rating in Kva.	Hours Between Readings	Number of Consecutive Readings Which Must be Nearly Constant
1 to 50	2	5
51 to 200	3	4
201 to 2,000	3	6
2,001 to 10,000	4	6
10,001 to 30,000	4	8
30,001 to 50,000	4	10

Drying electrical equipment occasions delay, expense, inconvenience and possible damage. Therefore, measures are taken to prevent absorption of moisture during transit. Transformers are often shipped in tanks filled with oil or gas, and motors and generators are protected from the weather.

Electrical equipment should be delivered so as to avoid storage. If storage is necessary care must be taken to keep it dry and clean, to eliminate fire hazards and to

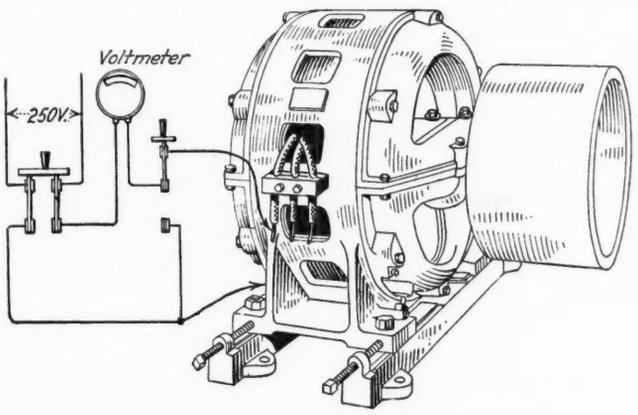


Diagram of connections for measuring insulation resistance with a voltmeter

prevent damage by rodents. If feasible, the equipment should be maintained at a temperature 10 deg. C. above that of the outside air to prevent condensation of moisture.

Electrical machinery stored in a dry, warm atmosphere will remain dry. But it is surprising the amount of moisture that will be absorbed by equipment kept in a damp location. In many localities insulation resistance of unused equipment not thoroughly protected may decrease 80 per cent in three or four months.

For fibrous insulation suitably treated it is agreed that 105 deg. C. is the limiting maximum temperature. Thus, for this insulation care must be taken during the drying not to exceed this temperature, or damage may result.

Three methods may be used to obtain the temperatures of electrical equipment. In the first method mercury or spirit thermometers, resistance thermometers or thermocouples are applied to the hottest accessible parts of the completed machine. This is the most common method. The mercury or spirit thermometers used for this service have a range of approximately 10 to 120 deg. C. Spirit thermometers should be used in transformers where the mercury from a broken glass might cause trouble if it got into the windings.

Thermometers should be well secured in place, and their bulbs covered to prevent radiation with felt pads, putty, fireclay, or steam-pipe insulation mixed with water and applied as clay. Since curve-drawing instruments give continuous records, their use is desirable on equipment being dried. Several thermometers should be placed about a machine, the reading of the hottest one being of most importance.

In Method 2 the average temperature is obtained by a comparison of the hot and cold resistances of the winding. Roughly, the temperature rises 1 deg. C. for each 0.4 per cent increase in resistance. The cold resistance can be obtained from the manufacturer, or calculated from simultaneous voltmeter and ammeter readings, using direct current. Current must not be passed through the winding for 24 hr. previous to making the measurement and not more than 20 per cent of full-load current should be applied. The cold resistance $= \frac{E}{I}$; E being measured at the terminals of the winding and I the current for voltage E. Method 2 is widely used to determine the resistance of rotor and transformer windings. When the resistance of a winding connected between slip rings is being taken, encircle each ring with a copper band, and attach the test leads to the bands.

The hot temperature of a copper winding is found by the formula:

$$T = \left[\frac{RT}{Rt}\ (234.5 + t)\right] - 234.5$$

T = Temperature of the hot winding in deg. C.
RT = Resistance of hot winding in ohms.
Rt = Resistance of cold winding in ohms.
t = Temperature in deg. C. corresponding to Rt.

Assume that the resistance Rt of the cold winding is 8 ohms at a temperature t of 25 deg. C. and the resistance RT of the hot winding is 10 ohms, the temperature of T of the winding will be:

$$T = \left[\frac{10}{8}\ (234.5 + 25)\right] - 234.5 = 89.88 \text{ deg.}$$

With Method 3, thermocouples or resistance coils are embedded in the winding, the temperature being read on an indicator. Since by means of Method 3 the maximum temperature can best be obtained, it is the most desirable method. But it is generally used for large equipment only. Table II shows the maximum allowable air temperature to use in drying electrical equipment, based on the different methods of measuring the temperature.

TABLE II—DRYING TEMPERATURE LIMITS FOR FIBROUS INSULATION

Method of Drying	Maximum Temperature, Deg. C. Method 1	Method 2	Method 3
Hot air	85 incoming air	90	90
Natural draft	85 outgoing air		
Hot air	85 incoming air	90	90
Forced draft	85 outgoing air		
Internal heating without oil	80	80 for motors and gens. 70 for transformers	85
Internal heating in oil	75 to 85 at top oil, depending on current used	70 for transformers	90
Drying in oven	85	90	90

When drying is wholly or partly by heat produced from current flowing in the winding care must be taken to increase the current only at such a rate as will insure against excessive internal temperatures. Embedded temperature detectors quickly respond to current changes, but if thermometers are used the time lag may be considerable, and with the change-in-resistance method the resistance cannot be measured while the heating circuit is connected. From three to seven hours should be taken to gradually bring the temperature of a winding to the dry-out temperature, the length of time increasing with the size of the equipment.

A PROPHECY FULFILLED

By JOHN LAWRENCE
President, Thos. E. Murray, Inc.

THE LATE Thomas E. Murray, who was responsible for many notable improvements in large power stations in this country, offered the following prediction many years ago, with respect to large capacity boilers:

"I shall not be satisfied until I have a boiler with heat-absorption walls on all sides of the furnace. If I can accomplish this, it will result in the elimination of heavy refractory walls, which are the greatest drawbacks to continuous operation at high ratings. It will enable us to design pulverized fuel burning boilers with relatively small furnaces. Our present furnaces cannot withstand the punishment from the jets of burning coal, especially if we attempt to get considerable overload. We can also materially cut down the volume of the boiler house if the boiler unit can carry a high overload for a long period. This will result in lower realty and plant investment, lower maintenance charges and, consequently, lower cost of power production. The water-wall furnace will so radically change our ideas of the design of steam generating units that I expect we shall soon have a boiler of one million pounds' capacity per hour."

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WHEN Hell Gate station was built it represented the most modern design, and in order to obtain the full capacity of the generating equipment, it was necessary to operate the boilers at higher ratings than any station had ever been designed for. While it had been appreciated that these high ratings would entail high maintenance costs, these proved higher than had been anticipated. The walls did not collapse, as they had been constructed in such a way that this was practically impossible, but the refractory material, which was of the best quality obtainable at the time, could not withstand the punishment.

When Mr. Murray looked over the maintenance figures, he was amazed, and said that power companies could not afford to pay such costs for furnace maintenance and also lose the use of the large investment for the periods necessary to repair the furnaces. He then suggested the idea which he had been evolving in his mind for many years and on which he had made many studies, namely, water-cooling the furnace. The original installation of water-cooled furnaces was in connection with three 15,500-sq.ft. boilers with underfeed stokers. Fig. 1 shows a cross-section of one of these units.

It is not necessary to discuss here the results obtained. Probably no boiler installation has ever received the publicity accorded those three boilers at Hell Gate station. The particular thing that appealed to Mr. Murray was that the boilers could be operated up to 600 per cent of rating without trouble. The only limitation was the capacity of the induced-draft fan motor.

The next installation also consisted of three boilers. These were more successful than the earlier three and, although the surface had been cut from 15,500 sq.ft. each to 12,100 sq.ft., the efficiency on test was higher throughout the range of operation. At the best point, the efficiency was 1 per cent better and 3 per cent better than the original boilers with refractory walls. Engineers were surprised to find that although the boiler had been cut down approximately 20 per cent in heating surface the point of best efficiency was practically at the same total evaporation per hour.

At about the time that these boilers were being installed at Hell Gate six small boilers were being erected at Sherman Creek station. These were to be used only for peak loads and were to be fired with fuel oil. Twenty years previously Mr. Murray had experimented with pulverized fuel, but had abandoned the experiments.

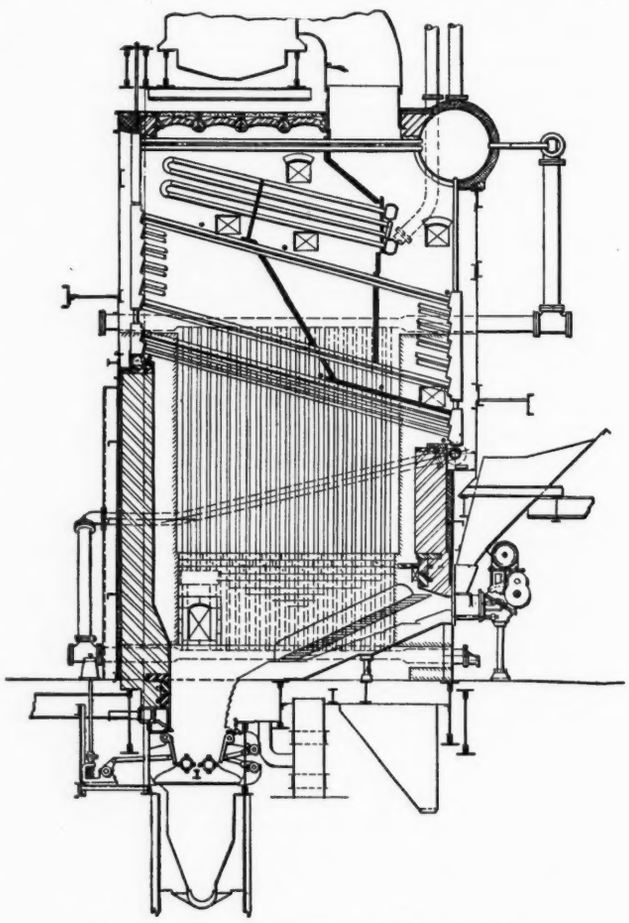

Fig. 1—Cross-section through Hell Gate boiler

After visiting a number of representative power stations where he observed pulverized fuel burning, he came to the conclusion that for economical utilization of this form of burning coal it would be necessary to use

water-cooled furnaces. He did not receive much support in the idea, but determined to make the experiment on the boilers to be installed at Sherman Creek station.

Results of tests on these boilers were so promising that it was decided to use pulverized fuel for the new East River station of the New York Edison Company.

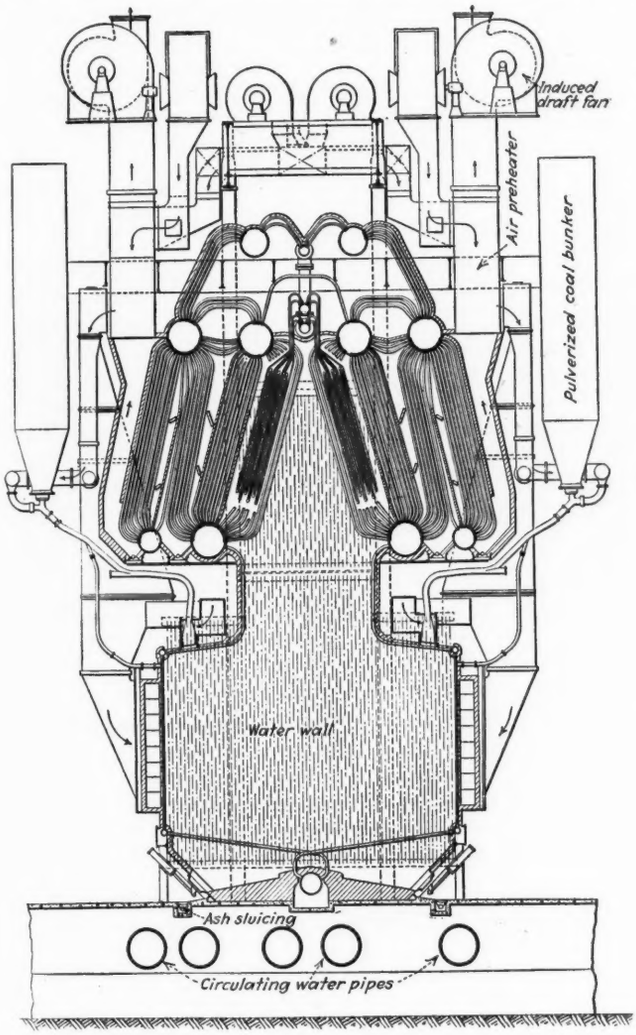

Fig. 2—This boiler at the East River Station has evaporated 1,250,000 lb. of steam per hour

This was to be the largest station projected and, owing to the physical drawbacks of the property selected, it would be almost impossible to revert to stokers on the ultimate extensions if the pulverized fuel installation did not turn out satisfactorily.

The boilers were of the same general design as those installed at Hell Gate station, but employed higher pressure. They have probably had the best record of availability of any boilers ever built. The only trouble experienced with the walls was due to excessive length of fins. After the corrections had been made on the length of fins, no further trouble developed, and only one side-wall tube had to be replaced last year. This replacement was due to a design which can be eliminated in the future.

When the boilers were started, it was found, as had been predicted, that the combustion was not satisfactory. However, changes were made in the burning equipment, and today very high efficiency is being obtained. In fact, at 386 per cent of rating on the boiler proper, the efficiency of the boiler, superheater and furnace was over 86 per cent on test. The boilers operated at approximately 400 per cent of rating over a period of months, until the new boilers were installed last summer.

A maximum capacity of 300,000 lb. of steam per hour was obtained from one of the units, although the equipment had been designed for only 237,000 lb. The only limitation was the capacity of the induced-draft fans to exhaust the gases from the boiler.

Operation at East River convinced Mr. Murray that enormous capacity could be obtained in one boiler unit. Every time he visited the station, his first question was whether higher ratings had been obtained from one of the units. This seemed to be the thought uppermost in his mind. He saw in those units the forerunner of fulfillment of his prophecy, and ordered his associates to design units far greater in capacity than had ever before been contemplated. Fig. 2 shows the design adopted as meeting the requirements for high capacity in limited space. The unit was proportioned for a rating of 1,000,000 lb. per hour, but it was expected that considerable overload would be available. When the operating company purchased the units the furnace was decreased in size and the rating was cut to 800,000 lb. per hour. Recent tests on one of the boilers showed a capacity as high as 1,250,000 lb. per hour, and it is believed that even greater capacity can be obtained from these units.

The steam output at 1,250,000 lb. per hour is sufficient for a station of 125,000 kw.—more than is required by a city the size of Washington, D. C.

There has been considerable written in technical magazines about the desirability of having one boiler large enough for the maximum capacity of a turbine. At the present time there are in operation in the world only five turbine units requiring more steam than the capacity of one of the East River boilers.

Carbon Deposits in Diesel Engines

By J. W. Peterson

IN visiting various Diesel plants, I many times find the engineer engaged in the laborious task of removing accumulated carbon from exhaust ports, exhaust valves and exhaust pipes. It is a job that must be done, because all fuel oils and lubricating oils are made up of hydrocarbons that, on burning, form water, carbon dioxide, carbon monoxide, and carbon. The first three products compose the exhaust gases that go out through the stack, but a large portion of the carbon is deposited behind the piston rings, in the combustion chamber and in the exhaust chambers and pipes.

In making surveys of plants, I find that the engineers who have given some thought to carbon accumulation have installed air filters and oil centrifuges.

All engineers know that air contains foreign matter in the form of dust and dirt, part of it being of an abrasive nature, but they doubt that there is sufficient foreign matter in the air to be of any consequence. These same engineers perhaps do not appreciate that a 6-cylinder, 14x17-in., two-stroke-cycle engine running at 257 r.p.m. requires approximately 3,361,000 cu.ft. of air every 24 hr. to furnish the necessary oxygen to burn the fuel oil. If an engineer wishes to be convinced that there is considerable dirt in air, he needs only visit a large theater and note the amount of foreign matter that is

removed from the air previous to its being blown into the theater.

An oil centrifuge does not affect the amount of carbon formed in the exhaust passages of an engine unless used oil is added to the lubricator that supplies oil to the cylinders. However, a centrifuge does reduce materially the amount of carbon deposits in the crankcase.

Most engineers are of the opinion that the choice of a lubricating oil has a great deal to do with the amount of carbon deposits. Comparative engine carbon tests made by various engineers indicate that they are correct in their opinions. Tests with two-stroke-cycle solid-injection engines have shown that some oils will form six times as much carbon behind the rings and in the exhaust chambers as certain other oils. The range of difference will, of course, vary with the load and the mechanical condition of the engine. Though there is no definite relationship between specifications of an oil and the amount of carbon deposits, one can feel safe in assuming that an oil with a low Conradson carbon value will form a relatively small amount of carbon in the engine.

One method of removing carbon from two-stroke-cycle engines consists of cleaning the exhaust pipes with some crude type of scraper. If the exhaust pipes extend into a pit, it is usually necessary to get down in the pit and shovel out the carbon accumulation. This latter job is somewhat unpleasant because of the wet, sticky nature of the carbon, and, as a result, is only performed about once or twice a year in most plants.

A second method, which is becoming more common, consists of burning out the carbon. The engineer first removes the exhaust pipe plates and places a burning, oil-soaked rag in the exhaust pipes. He then replaces the plates in such a manner that there is a partial opening for air. It usually requires fifteen minutes or more, depending on the amount of carbon, to burn out the exhaust pipes, pit and stack. It is the practice in some plants to perform this job about once a month.

There are certain precautions that should be observed. If the pit contains considerable carbon, it should be cleaned before the carbon in the exhaust pipes is ignited. The carbon should not be burned out during a high wind, because of the fire hazard to surrounding properties.

In a multi-cylinder engine the burning rag should be placed in the exhaust pipe nearest to the stack, igniting the carbon in each pipe in succession.

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Island Falls Project Will Have 44,500 Hp. Installed Capacity

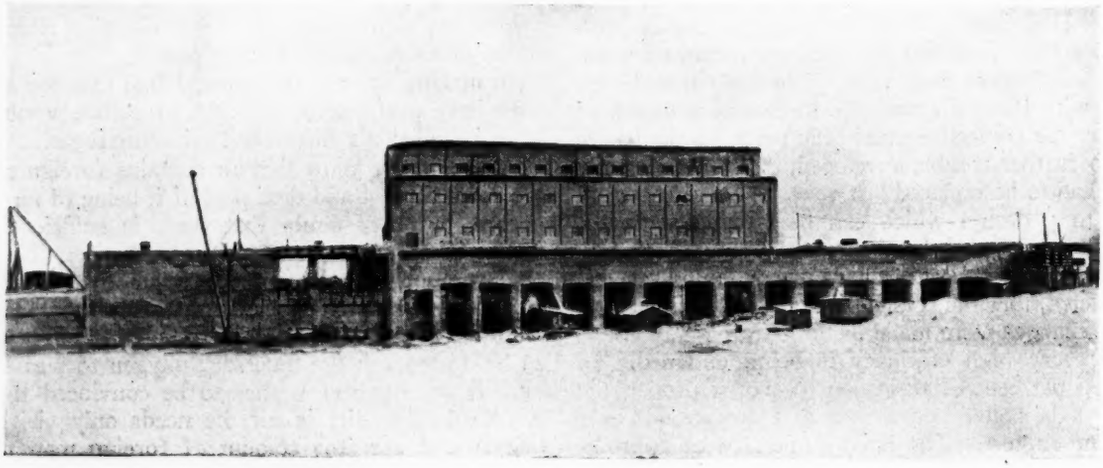
AT Island Falls, on the Churchill River, in the province of Saskatchewan, Canada, a large water-power development is under construction. The plant is situated about 15 miles west of the Manitoba boundary and, with the exception of a small development in the Yukon, is the most northerly hydro-electric power plant in Canada. It is being built by the Churchill River Power Company, subsidiary of the Hudson Bay Mining & Smelting Company, to furnish power for the big Flin Flon and Sheritt-Gordon copper mines in Manitoba.

The power plant will have an initial installed capacity of 44,500 hp., with provision for a future extension to a total of 86,500 hp. Three 14,500-hp. vertical-shaft, single-runner turbines and two 1,250-hp. auxiliaries are being installed now, with provision for three additional units when the power demand warrants them. The main units will operate at 163.6 r.p.m., and the head will be about 60 ft. They will be direct connected to three 12,000-kva., 3-phase, 60-cycle generators. Power will be generated at 6,600 volts and stepped up to 110,000 volts for transmission to the Flin Flon and Sherritt-Gordon mines.

The power plant, situated on the right bank of the river, forms an integral part of the main dam. The latter is a gravity-type concrete structure with four gate-controlled undersluices each 12 ft. wide x 24 ft. high, and sixteen stop-log-controlled spillway openings each 15 ft. 6 in. wide. The combined discharge capacity of the undersluices and spillway on the top of the main dam is 95,000 cu.ft. per second. In addition to these structures, there is a concrete spillway dam about a mile south of the main dam. It will have 46 stop-log-controlled openings each 15 ft. 6 in. wide, with the sill at elevation 112, and a discharge capacity of 100,000 cu.ft. per second. There will also be five earth-filled side dams.

The power house structure is 200 ft. x 112 ft. and contains 1,460,000 cu.ft. The generator room of the power house will be equipped with a 75-ton gantry crane, and 25- and 40-ton cranes of the same type will be installed in the power house head works and over the undersluice gates, respectively.

Power for construction purposes is derived from a small temporary hydro-electric plant built on the Swan River about 13 miles northeast of the Island Falls power site.



. . . RIGHT OUT OF THE PLANT . . .

Enameling Governor Handwheels Aids Operator's View

A METHOD we use to make our turbine governor handwheels clearly visible to the switchboard operator may be of interest to other readers.

All of the governors with one exception are in sight of the switchboard operator and he always watches the handwheel to see if it is turning when he closes the switch to the governor spring-tension adjusting motor to vary the load on any particular machine.

As the handwheels are rather hard to see against the machine's background, we have painted each one with alternate stripes of red and yellow, using vivid bicycle enamels. This makes the handwheels stand out clearly and oil on them only makes it easier to keep them bright.

One stripe of white lead was formerly used, but oil soon discolored it and it was hard to see.

Nashville, Tenn. THOMAS E. MILLER.

Experience With Zeolite and Acid at Beacon St. Plant

"IT IS CONTENDED that more attention should be given to the prevention of corrosion, the efficient use of salt and the control of water flow in the design of zeolite and acid systems." This is the sub-head of an article, "Experience With Zeolite and Acid at Beacon Street Plant," appearing in *Power* of April 8, and as manufacturers of the zeolite system in question we feel we are called upon for an explanation.

The original installation at Beacon Street consisted of two 10x25 ft. horizontal green-sand softening tanks with brine tanks. The third unit of the same size was added approximately three years later, during which interval numerous improvements had been made in this make of zeolite softener. At the time the first two units were purchased wrought-steel pipe was standard construction, but before the third unit was purchased this company standardized on wrought-iron pipe, both internal and external.

Sometime prior to the purchase of the third unit, our firm also solved the problem of shifting gravel beds in horizontal units by partitioning off the gravel bed with vertical steel partitions (patent applied for). Improvement in the design of strainer systems in vertical units solved completely the gravel-shifting problem in such units, but additional factors present in the large horizontal tanks caused difficulty until the invention of the bulkhead system. The double unit, horizontal, green-sand zeolite softener at the Philadelphia Electric Company plant is only one of several in which this system was used before suggested to the Detroit Edison Company.

It is essential in up-flow zeolite softener design that water distribution be uniform throughout the bed, for otherwise the other obvious advantages of up-flow over down-flow may not compensate for the troubles resulting from improper distribution.

On the matter of efficient use of salt, which applies to all forms of zeolite softeners, it is not possible to obtain 100 per cent reaction of the salt employed. The usual figure of half a pound of salt per 1,000 grains exchange represents three times as much salt as is chemically equivalent to the hardness removed. The apparent excess salt is necessary to carry out the reconditioning action. The need of excess salt is to provide pure salt solution to wash the impure salt from the mineral. If water follows the first brine immediately, the impure brine is diluted and the diluted brine loses calcium and magnesium to the mineral. The softener in question operates to give 3,375 grains exchange per cubic foot of mineral. If a lower exchange be employed the salt consumption can be lessened slightly, but at the expense of more frequent reconditioning and its attendant cost in wash water.

FRED O. PAIGE, JR.,
Hammond, Ind. Paige & Jones Chemical Co., Inc.

Accident to Turbine Blower Through Reversal of Rotation

THE "Accident to a Turbine Blower" described in the April 15 number, wherein one of two units connected to a common header was driven backward by the other unit, is worthy of comment.

Such danger is especially great when two or more machines operate in parallel. If the units are turbine-driven there is always the possibility that the overspeed emergency trip of one of them will unlatch and shut off the steam. Motor-driven units may similarly lose their power through the functioning of fuses or other protective devices.

Should this happen, the pulsation or "squeeling" of the stalled machine will warn the operator that something is amiss, but he may be unable to get the air valve closed in time to prevent reversal, or he may make the natural but unfortunate mistake of trying to shut off the power.

Best practice, therefore, dictates the use of check-valves in connection with machines operated in parallel. The additional investment and increased power consumption will usually be warranted by reasons of safety.

Regarding the damage that may result from reversal, this will in all probability be restricted to the bearings or, in the extreme case of rubbing of internal parts, will be the direct result of bearing failure. With ring-oiled

bearings no trouble should be anticipated. Overspeeding of the reversed machine resulting in the destruction of the rotor is an impossibility, explained as follows:

Air is compressed centrifugally by imparting to it a high velocity by means of a rotating impeller wheel. This velocity is then converted into pressure by reducing the velocity in suitably shaped passages; a process which is the reverse of expansion.

If the resulting pressure is later used to reproduce velocity by re-expansion, the resulting velocity cannot exceed the original. It will, in fact, be less due to unavoidable losses. It is apparent that the driven impeller (that of the reversed machine) cannot exceed the velocity of the air which impels it and that, therefore, the speed of the driven impeller cannot exceed the speed of its driver, but will, rather, be less. Assuming equal impeller diameters and an equal number of stages in the two machine, the r.p.m. of the reversed machine will be less than that of its driver.

An accident of the type under discussion came to the attention of the writer. The two units involved were turbine-driven and of the type in which the oil-operated governor valve is held open by the oil pressure. Each machine had two oil pumps; one driven from the main shaft, the other an auxiliary arranged to cut in at low pressure. The accident happened when both machines were slowed down for a short period. The auxiliary pump of one unit failed to cut in instantly, and the decreased pressure allowed the governor valve to close. The machine reversed, and although the auxiliary pump had by this time cut in and was running furiously it could not build up pressure again, because the main oil pump was now operating in reverse and was pumping oil from the system as fast as the auxiliary pump could deliver it Consequently, there was insufficient oil pressure either to admit steam to the turbine or to lubricate the bearings. The damage was limited to the burning out of one bearing.

This type of accident is possibly more common than one would expect; and in some cases the true cause of the loss of bearings, that is, reversal, may be entirely overlooked. In any event the subject is worth consideration by those operating this type of equipment.

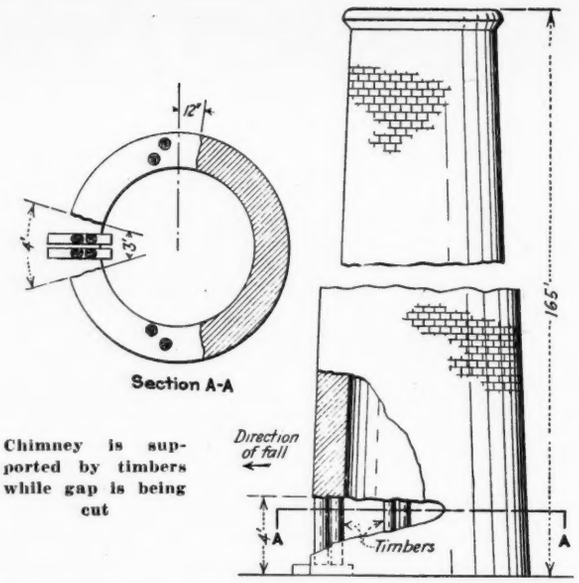
Madison, N. J. B. F. POWELL.

How a Brick Chimney Was Razed

SOME time ago there was an article in *Power* on "How a Brick Chimney Was Razed." It was interesting, but it seemed to me that not sufficient care was taken to safeguard the workmen and other persons in the vicinity.

Upon reading the article one of my apprentice engineers asked me this question: "Is there not a possibility of it coming down while the cutting of the gap is in progress?" This is a practical question, and one worthy of consideration. Suppose the gap is nearing the vertical axis and there is a strong wind in the direction of the fall of the chimney. Men are loitering in the vicinity and those who are cutting the gap are busy in their work and do not anticipate the probable time of fall. If the wind pressure should suddenly increase the chimney might fall by its own weight even before the center line was reached.

I outlined to my apprentice a more practical and safer method of doing this work, as follows: Take the same



chimney, 165 ft. high, 13 in. diameter at the bottom and 9 ft. at the top. First make a hole 4 ft. wide in the outer wall, say 4 ft. from the ground, tapering inside to 3 ft. Pack it with dry firewood logs standing vertically, as if you are propping it. Proceed with further excavation simultaneously on both sides and when within two feet or so of the center line, put other logs in the gap and pack them snugly. Then continue cutting till you go beyond the center line, say one foot or a little more. When this point is reached, stop cutting and warn all men to clear beyond the zone of the fall.

When the site is clear put kerosene on the log packings and ignite them. When the logs have burned out the chimney will come down by its own weight. The log packings will prevent accidental fall of the chimney and permit the work to be finished without any danger to workmen or other persons in the immediate vicinity.

Ahmedabad, India. M. M. VYAS.

More on Benson and Loeffler

THE ARTICLE, "Benson plus Loeffler," in *Power* of April 15 is most timely, and the author, Wilhelm Firing, should be congratulated for bringing up this question. The writer has been closely following the developments in coil boilers and considered the discussed combination of Benson and Loeffler elements some two years ago, from the standpoint of operating flexibility and temperature control.

It is high time that boiler designs better suited to high-pressure work be discussed at length. The whole future of high-pressure steam operation depends on the development of cheap boilers. Any substantial decrease in cost can be effected only by elimination of the heavy forged drums pierced by hundreds of holes and by fuller investigation of the common boiler materials which seem to be better suited than the alloy steels for work under high thermal load.

There are several other designs of coil boilers answering the purpose, for instance the Brown-Boveri boiler made by Humboldt Werke, the Doble boiler in this country, the Schmidt-Hartmann boiler with indirect heating and the latest Brown-Boveri boiler with combustion under pressure, also made by Humboldt.

High steam pressures are uneconomical unless the

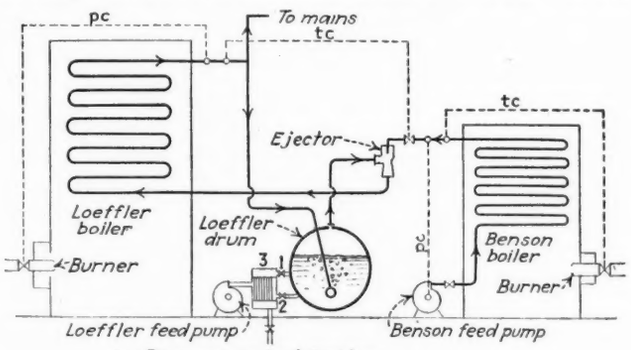
temperature of steam is high also and the available tube materials are put to work almost at the limit of their endurance. Creep phenomena in high-pressure high-temperature work are the controlling factor; therefore any boiler designed for such work should be considered first from the standpoint of temperature control.

The amount of water in Benson coils is insignificant, and the necessity of simultaneous control of pressure and temperature puts a serious handicap on regulating the steaming rate. The operation and control of Benson boilers have peculiarities entirely their own, due to which the scheme as shown by Mr. Firing does not allow the simultaneous controlling of the steam output (pressure) and temperatures by adjusting the firing in the common furnace; hence separate furnace should be provided.

The scheme as developed by the writer and shown in the sketch indicates the possibility of proper and positive control if separate furnaces are provided. In Mr. Firing's arrangement no provision has been made for the water-level control in the Loeffler drum, and the fluctuations possible in both directions cannot be met by a feed regulator alone. The Brown-Boveri plan of successive stages consisting of drum and superheater elements is free from the control trouble but seems to be expensive. There is one drawback to the scheme of Mr. Firing, the doubling of feed pumps. The cost of feed pumps for a Benson boiler is a large fraction of the boiler cost.

Considering any composite system—the Loeffler and Benson or the Brown-Boveri operating at high pressure —attention should be called to the large pressure drops across the superheaters. The high velocities of steam necessary for proper cooling effect at high densities produce pressure drops of the order of 100 to 400 lb. per square inch or even higher. At variable rating this would give trouble with the usual types of control.

Of course, many solutions are possible, and probably many patents and preliminary designs are stored in the files and vaults of boiler people ready to meet the real demand. But so far the customers are not aware of the great possibilities of coil boilers and are content with the extra-strong old types. They bear troubles with good humor, helping to intrench and secure the first step to 650 lb. pressure and the second to 1,200 lb.



Another arrangement of Benson and Loeffler elements

We had the pioneers: Moultrop and Anderson in this country were responsible for the second step. But we need another leader to make the next logical step toward simpler steam generators of the coil type, as Herry did when he ordered a Benson boiler for the pioneer high-pressure station at Langerbrugge.

N. Artsay.

New York City.

Rotary Converters Used for Power-Factor Correction

ROTARY or synchronous converters have been used for power-factor improvement almost as long as they have been in existence. Operating conditions in Chicago, New York City and similar localities where rotary converters are supplied over comparative short high-voltage, underground transmission lines, are radically different than those on the Pacific Coast, where rotary converters are supplied over long, high-voltage, transmission lines from hydro-electric plants. In the former, power-factor correction may be carried as far as heating of the machine or commutation will permit, whereas in the latter freedom from hunting may decide how far power-factor correction can be carried.

Neglecting commutation, how far one can go in over-exciting a synchronous converter will depend upon the relative resistance and reaction of the supply line and of the machine's armature. A synchronous converter will be more unstable on a high-resistance circuit than on one of low-resistance. This explains why rotary converters are now designed for higher impedance than formerly and why a high-impedance machine has greater stability and higher overload capacity than lower impedance units.

There is a certain excitation that will give unity power factor, while a decrease in shunt-field excitation will cause a lagging power factor, and an increase in field excitation will result in a leading power factor. Railway synchronous converters are usually arranged for a certain no-load power factor, and the series-field winding is then adjusted so that the power factor will have a greater lead with increasing load. Power-factor correction is not the only element involved. Nor is the heating of the machine, particularly at the tap coils, the only difficulty or danger to be guarded against. When power-factor correction is carried too far, rotary converters become unstable and may flash over and fall out of step. A synchronous converter will be more stable and less likely to fall out of step when it takes a leading current instead of a lagging current. If the increase in armature voltage is carried too far, however, the current input will become too great, causing excessive heating.

Every synchronous converter has a definite range of load and phase displacement beyond which it becomes unstable. An induction motor will gradually slow down. A rotary converter cannot change in speed, but must remain in synchronism with the system until it suddenly and abruptly stops, interrupting the power supply or burning out. This falling out of step or stopping of the rotary converter is caused by the condition that makes it able to carry load, namely, the phase swing of the armature electromotive force with respect to line voltage. Operation of the rotary converter becomes unstable when the phase angle between armature current and line voltage is less than a definite value. This value ranges between 100 and 120 deg., depending upon the resistance and reactance of the armature.

The range of driving power and, in turn, the maximum capacity of the machine, are dependent upon the field excitation and armature constants. The stronger the field within practical limits, the greater the driving power of the machine, the longer it is able to stay in step, and the heavier the load it can carry. High-impedance machines will not only have greater stability with rapidly and widely varying loads, but will also have higher overload capacity than low-impedance machines.

Chicago, Ill. I. L. Kentish-Rankin.

From Among Readers' Problems

Conducted by
L. H. MORRISON

INDEPENDENT STACKS FOR HORIZONTAL RETURN-TUBULAR BOILERS — *For a factory power plant, begun with the installation of two horizontal return-tubular boilers that probably will be duplicated within a year, would it be better to supply each boiler with a separate steel stack set over the uptake?*
J.B.N.

The best draft control would be obtained by furnishing each boiler with a separate stack, but placing the stacks directly over the boiler uptakes is objectionable on account of the expense of providing supports suitably independent of the boiler settings, and trouble will be experienced from soot and scale dropping from the inside of the stacks into the uptakes of the boiler. The arrangement also would be likely to give trouble from rain water running down the sides of the stacks and finding its way to the boiler settings.

These disadvantages can be obviated and nearly the same draft advantages of independent stacks can be secured by setting the stacks at the sides of the settings or to the rear of the firing spaces, and providing the connections from the uptakes to the separate stacks with easy bends.

For most situations the independent stack supports and connections should cost no more than proper provision for independently supporting the stacks directly over the uptakes of the boilers.

—◆—

A GROUND DETECTOR FOR A GROUNDED SYSTEM — *Two large manufacturing plants,* A *and* B, *are supplied with 115- and 230-volt power from a power plant located in building* A. *The feeders supplying plant* B *are 3-wire 115 and 230 volts and of 4,000-ampere capacity. The neutral wire is permanently grounded in the power plant, through a 3-ohm resistance capable of carrying a dead ground load on either outside wire. What would you suggest for a ground detector at a point between the two plants to indicate whether an accidental ground is in building* A *or in building* B? E.T.M.

Apparently you are attempting the impossible. The system has a permanent ground on it, yet you wish to put on a ground detector. Any detector put on the system would detect the ground that is permanently on the system. Furthermore, a ground on the outside legs, on any but the larger circuits, would blow the fuse protecting the circuit. A differential ammeter connected in series with the ground connection would indicate the flow of current to ground, and the direction of this flow. Current flow is between the neutral and one side of the circuit. The ground ammeter would not indicate whether the insulation happened to be of poor quality on the two outside legs of the circuit.

If the system did not have a permanent ground on it, then it would be possible to use a differential voltmeter to indicate when a ground developed. However, this would not indicate the location of the ground on the individual feeders, as you suggest in your letter. No matter where the ground is on the system, the current will flow in the same direction through the instrument whether the ground is on the generator end of the feeder or on the supply end.

Probably it would be best to connect an ammeter in series in the neutral ground, and this will indicate any appreciable current leak between the neutral and one side of the system. As pointed out, this will not indicate the flow of current between the two outside legs of the circuits, but it is not likely that the two outside legs of the circuit will have poor insulation at the same time.

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

THE front head of the drum on one of our water-tube boilers has a crack at the joint that extends through six rivets. Will it be safe to weld this joint if the state inspector consents? C.V.

WELDING of the crack at the rivet joint of the drum of a water-tube boiler should not be permitted under any circumstances; for welding has not yet reached that stage of perfection where it can be depended upon for such work.

One of the serious drawbacks in welding as applied to boilers and unfired pressure vessels is the human element, and until such time as this matter can be straightened out all construction subject to loads or stresses and not properly supported by other construction should not be welded.

In New York we do not allow welding of the girth seam of boilers when the crack extends from rivet hole to rivet hole girthwise. We would therefore prohibit the welding of the crack in question.

I hardly believe any state inspector or insurance inspector thoroughly conversant with boilers and their construction would permit cracks in drum heads of boilers to be welded.

Paragraph 186 of the A.S.M.E. code reads as follows: "Autogenous welding may be used in boilers in cases where the stress or load is carried by other construction which conforms to the requirements of the code and where the safety of the structure is not dependent upon the strength of the weld." Therefore, if welding is not permitted in new construction it is reasonable to believe that it would not be considered good practice to allow it on existing boilers.

It would be advisable to ascertain just why the drum head cracked as it did, considering the stresses, ductility, and tenacity of the plate, and also to make sure if the drum head plate had not crystallized and lost its strength and flexibility.

CHARLES W. CARTER, JR.,
State Boiler Inspector.
Binghamton, N. Y.

—◆—

IF THE state inspector consented to welding the head, it would naturally be assumed that it is safe to weld it. Welding of certain parts of boilers has been approved by some states, and also has been adopted as standard practice by many builders, who weld every part that is practicable and, of course, approved.

Generally, however, welding is permitted or approved only on those parts of the boiler that are not in direct

contact with the source of heat. As the head of a water-tube boiler is not exposed directly to the source of heat, it should be safe to weld. Welding of any part of a boiler must be considered an important weld. Therefore, it should be done only by an expert, a man who is licensed by the state, which means he has submitted specimens for tests and has passed a rigid examination.

No information regarding preparation for the weld need be required by the welder, but for the benefit of the engineer, who may not be familiar with usual practice of cutting away sufficient metal on each side of the fracture to permit a properly executed job, I submit the following suggestions:

If the crack starts midway between rivets, cut the sheet back to the rivet where there is no chance of a slight fracture extending beyond.

Make sure that enough metal is removed around the side of the rivet nearest the crack to start the weld directly on to the rivet proper, and the first layer of metal should be welded to the underlapping sheet. Cut the metal in a V-shape, completely through, exposing the under sheet about $\frac{1}{4}$ in. all along the fracture. This method will not only insure a weld the full thickness of the sheet, but will at the same time seal the joint. No calking should be necessary when welded in this manner.

If an acetylene torch is used for removing metal in preparation for the weld, all traces of oxidized metal must be carefully removed before starting the weld, the weld being done by an electric arc.

After each layer of metal is applied, the finely oxidized metallic dust should be removed by a stiff wire brush before applying the next layer.

Build the weld at least an $\frac{1}{8}$ in. above the surface of the sheet, and completely lap over the two sides.

E. E. M. FERRELL.

Elizabeth, N. J.

I THINK it would be safe to repair the damage by welding. A good job of welding should be superior to single-riveting. The cracked portion and the six rivets should be removed and the cracked edge welded to the shell, the rivet holes being filled with weld metal at the same time.

There is no doubt but that the boiler of the future will be welded, excepting, of course, those of seamless construction. Eventually, concessions will be made by the proponents of riveting and the result will be a completely welded boiler. Condemning welding off-hand and accepting without protest a piece of equipment that has been fabricated by the tortures of riveting, strikes me as a bit anomalous.

The first concession might well be in favor of the welding of heads of drums. Whether the heads are of the old style with the small "knuckle" curve or of the modern "elliptical" kind they should be flanged, with the flange inserted into the shell and the ends of both flange and shell welded. The reason for this is that under pressure the head, not being completely spherical, tends to assume that shape, with a resulting high-compressive hoop stress in several inches along the shell. When the flange is merely butted to the end of the shell, the compressive stress is carried by only one thickness of metal, and, not being always truly circular, the end of the shell and the adjacent portion of the head are subjected to high local stresses, from which points cracks causing failure can be expected to start. With the flange of the head inserted into the shell, and both flange and shell welded, there is about double the thickness and four times the strength to resist local transverse stresses caused by departure from a true circle.

C. O. SANDSTROM.

Los Angeles, Calif.

THE PLATE should be examined thoroughly first, as such cracks may indicate improper metal in the heads. This can be done by drilling the head and having an analysis made for sulphur, phosphorus, and carbon. If these are in the prescribed limits, I would be willing to take a chance, although to be doubly sure a small section might be cut from the head and tested physically.

I assume that the welding will be properly done, and that the edges of the rivets will be merged into the joint. Then, as the roundabout seam of a drum gets only one-half of the stress of the logitudinal seam, the factor of safety will still be within bounds.

A crack like this is a suspicious thing. I have seen many on flue boilers when the nozzle was turned near the flange of the head, but as the flue carried the pressure there was no danger of the head coming out. Such a crack usually is caused by plate of too high carbon, too much impurity, sulphur or phosphorus, or flanging too cold, or by a combination of these. Modern steel will stand terrific abuse, and test higher physically than its constituents would indicate, and still a combination of circumstances may cause disastrous results.

L. R. BAKER.

Chicago, Ill.

WELDING of unstayed surfaces of water-tube boiler drums is not only an unsafe and impractical policy, but is also contradictory to the laws of the American Society of Mechanical Engineers, which state the non-permissibility of welding any boiler surface unless such is internally stayed and the safety of the structure is not dependent upon the weld alone. I am sure states having adopted a boiler code would not allow the building up of unstayed surfaces by welding.

The failure may be due to one of many common defects. This drum head may possess one or several certain weaknesses due to builder's workmanship, or defective steel. Again, poor water and undue stresses may have given an opportunity for pitting and corrosion at this part of the boiler. A special inspection should be made not only of drum but also of the entire interior of boiler, and everything checked and conslusions formed accordingly.

By no means weld this structure, even though the inspector gives permission. Instead, either cut out the head and replace it with a new one, or insert a patch with its edges covering at least two additional rivets on each side of the crack. It is best to cut out the defective portion to facilitate easier application of the new patch and to insure no leaks and better workmanship.

R. L. HAMILTON.

West Point, Ark.

MY OPINION is that it would not be safe to weld this joint, for two reasons. There must be something wrong chemically with the steel in the head to crack, inasmuch as the joint is not exposed to any excessive heat, as is the girth seam of a horizontal return-tubular boiler. It is assumed, of course, that the safe working pressure has not been exceeded.

The industrial code of the State of New York specifically states that cracks extending from rivet hole to rivet hole on girth seams of boilers shall not be welded.

I do not believe a state inspector would give permission to weld this joint; but if he did I would insist that this permission be in writing and signed by the chief inspectors of both the state and the insurance company.

W. E. BARBER, *Chief Eng.*,
Fenimore, Mills.

Hudson Falls, N. Y.

A Question for Our Readers

RADICAL changes have been made in the design of squirrel-cage induction and synchronous motors and their control during the last ten years that have made many of the older types of motors and control obsolete. I would like to hear from some of POWER's *readers how they deal with the problem of motor and control obsolescence. For example, if an old motor, started on reduced voltage, burns out, is this sufficient reason to replace the old equipment with a new motor that can be started on full voltage?* N.E.W.

Suitable answers from readers will be paid for and published in the June 10 number.

Loeffler vs. Schmidt-Hartmann

Another contribution to the debate on the relative merits of two German boilers

By K. ROCHEL

Manager of the Boiler Factory, Witkowitzer Bergbau — u. Eisenhüttengewarksch Maravska Ostrava, Czechoslovakia

It is not the desire of the editor to drag out a debate started by Dr. Loeffler's article in the March 19, 1929, number of *Power*. That article led, however, to a reply by O. H. Hartmann in the Oct. 29, 1929, number. Mr. Hartmann's arguments, in turn, drew the following rebuttal from Mr. Rochel. It seems only fair to present Mr. Rochel's paper here and then let the case "rest with the jury," in view of the decided and perhaps irreconcilable differences of opinion. *Power*, it need hardly be pointed out, is quite neutral in this discussion and has merely provided a forum for this interesting debate.

THE OPINION of Professor Loeffler (*Power*, March 19, 1929) that the high-pressure boiler of the "Schmidt'sche Heissdampfgesellschaft" has no positive and controllable water-circulation, seems to be held also by a well-known American engineer, C. F. Hirshfeld, of Detroit, who says of the Schmidt boiler: "Moreover the circulation of the heating medium is affected by convection, as in boilers of the ordinary type, and is subject to all the uncertainties that are to be anticipated in such boilers."[1]

There is no doubt that *forced circulation* of the cooling medium, by a pump, exactly regulated by its number of revolutions has great advantages over a flow maintained only by differences of temperature.

The Problem of Scale Formation

Professor Loeffler's opinion that scale could be deposited on the steam-heated surfaces in the boiler drum, seriously reducing the heating effect of the coils, is also held by Mr. Hirshfield, who says: "In addition, scale-forming water tends to incrust the outer surface of the coil in the drum which forms the steam generator, thus decreasing the effectiveness of the heating surface."

Tests made by Splittgerber with a Schmidt boiler prove the correctness of these statements. Splittgerber reports that the scale deposited on the vaporizer elements could be removed only with the aid of a scraper and brush, and that drawing off the mud in the usual way was not effective. It must be concluded that the deposits are hard to remove from the heating elements.

If Director Hartmann assumes that entrained water is carried into the superheater of the Loeffler boiler, this remains an assumption without proof. During continued operation for more than two years the Loeffler boilers in Vienna and at the Witkowitz plant have not shown any water or deposits in the superheater tubes.

The latest investigations on the loading of water-heating surfaces confirm these practical experiences. Professor Eberle-Darmstadt[2] published the results of careful tests on the loading of boiler surfaces and the influence of salt and mud on the entrainment of moisture. His tests showed that the limit of the evaporative capacity is 4,000 cu.ft. of steam per hour per cubic foot of steam space with pure water, and that this limit is unaffected by the pressure.

To show that in the Loeffler boiler this limit is not approached, the load of the steam space of the two Loeffler boilers now under construction in Moravska-Ostrava may be calculated here: Each of the two boilers has two drums of 43-in. diameter and 26 ft. length. Since these are half full of water, the free steam space amounts to 265 cubic feet.

As the safe load may reach 4,000 cu.ft. per cubic foot of steam space (according to Eberle), a steam production of $265 \times 4{,}000 = 1{,}060{,}000$ cu.ft. of saturated steam could be permitted with these boilers. Since the weight of one cubic foot of saturated steam at 1,850 lb. steam pressure is 4.8 lb., the two drums of one boiler may vaporize $1{,}060{,}000 \times 4.8 = 5{,}100{,}000$ lb. per hour. As these drums, however, vaporize only 330,000 lb. of steam, it follows that only one-fifteenth of the admissible limit of the load is attained. Under these conditions water cannot be entrained.

During his further investigations on the entrainment of water containing alkalies and suspended solids Eberle found that they reduce the limit of the load and that the different floating substances (not so much the alkalies) unfavorably influence the entrainment of water. It is therefore necessary to take care that a certain concentration of solids in the boiler water is not exceeded. This is prevented by blowing down from time to time.

The results of Eberle's careful investigations give no reason to expect that the Loeffler boiler should produce wetter steam than the Schmidt, if proper steam volume is provided. With the Schmidt boiler, however, it is very important to chose the dimensions of the heating coils and boiler drums so that it is unnecessary to fill more than half of the drum with water to maintain the required steam space. This, however, will frequently require considerable enlargement of the boiler drums, with a consequent increase in investment costs.

Entrainment of Water in Steam

Director Hartmann believes it an advantage of the Schmidt boiler—compared with the Loeffler boiler—that in the fire-heated tubes of the Schmidt boiler only pure (distilled) water circulates, so that no deposit of scale or burning of tubes is possible, which he supposes to occur with the Loeffler boiler. This opinion is erroneous, as no entrainment of water occurs in the Loeffler boiler. Loeffler boilers in constant operation for more than two years (using undistilled water) have proved that it is possible to build and operate safe radiant superheaters exposed to the direct effect of the flames.

Radiant superheaters prove that the pumped steam of the Loeffler boiler is, in fact, free of scale and entrained particles. After two years of operation parts of the superheater tubes were cut out and thoroughly investigated. The metallographic examination proved that in spite of the high pressure and the intense effect of the flames no alterations of the structure had occurred.

Although the tubes of the radiation superheater at the Witkowitz boiler con-

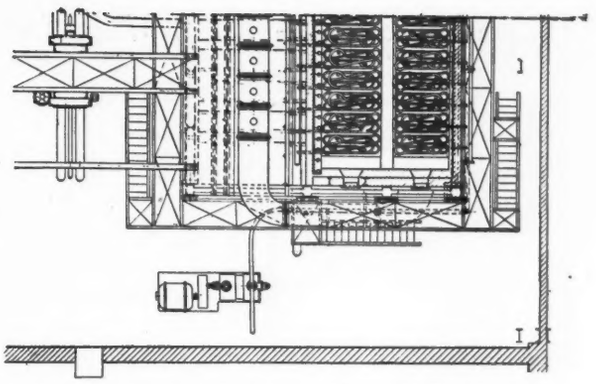
[1] *Mechanical Engineering*, page 733, Oct. 29, 1929.

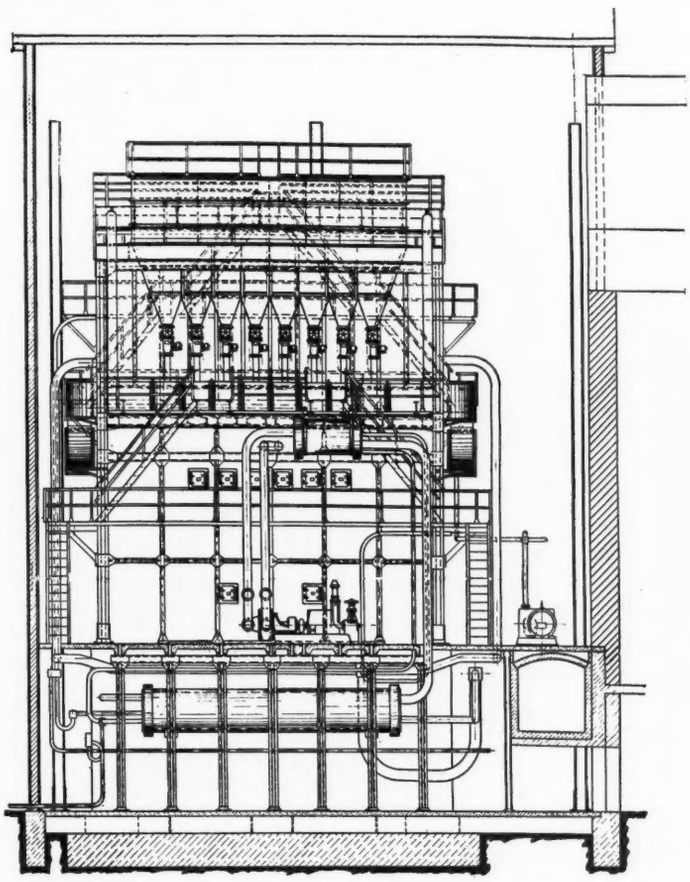
[2] *Archiv f. Waermewirtschaft u. Dampfkesselwesen*, Oct. 29, 1929.

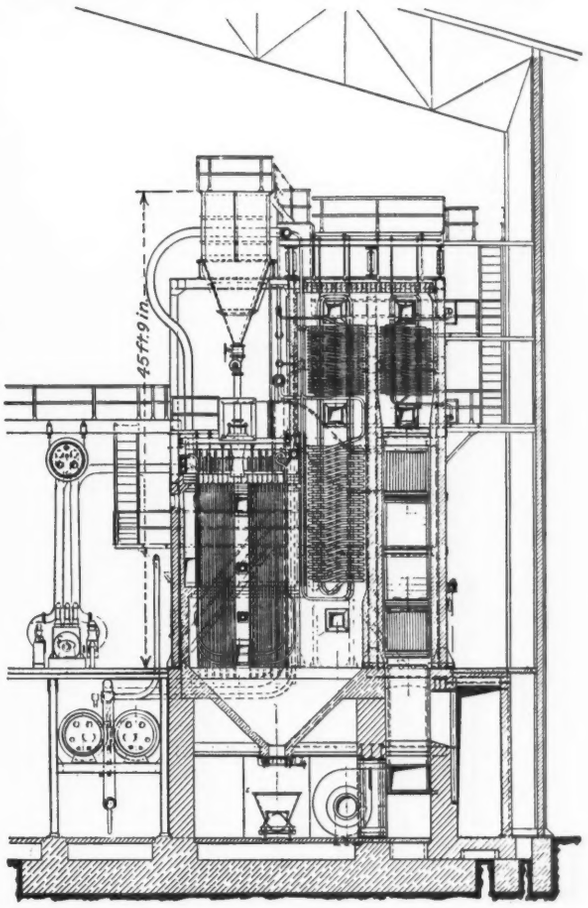
sist of normal carbon steel of 70,000 to 85,000 lb. tensile strength without alloy, *no signs* of aging of the material were found.

The cooling effect of the pumped high-pressure steam, together with the positive and controllable steam-circulation, proved a safe and sufficient protection from the intense concentration of heat.

Also, the Schmidt boiler has a directly fired steam superheater (for the working steam) which has to work under more difficult conditions than the steam superheater of the Loeffler boiler. In the Loeffler superheater the steam flow takes place by force and independently







Two Loeffler boilers of the type shown are being installed at the Witkowitz Coal Mines in Morovska-Ostrava

of the boiler load. On the other hand, the steam flow through the superheater of the Schmidt boiler stops when the boiler is unloaded without checking the fire. It is certain that the superheater is endangered by such working conditions.

Director Hartmann gives a list of the operating Schmidt boilers. It would be interesting to know which of these has proved superior in actual operation. According to the latest information the new Schmidt locomotive of the German "Reichsbahn" will differ considerably from the original locomotive, which was also modified several times during its operation. The new locomotive presents important fundamental alterations proposed by Oberbausrat Wagner of the German Railway Company.

The Loeffler locomotive has recently been finished by Maschinenbau A.G. Schwartzkoff-Berlin. Its first tests were successful. During the World Power Conference in Berlin (June 1930) it will be exhibited by the German Railway Company.

New Installation at Witkowitz Mines

In view of the excellent experiences with the Loeffler boilers operating in Vienna and at the Witkowitz coal mines in Moravska-Ostrava, the directors of the Witkowitz works have decided to base their total power plant on Loeffler boilers. Two more Loeffler boilers, representing the latest experiences of modern boiler construction, are now under construction. These are built as radiation boilers of high output and a great part of the total heat in the combustion chamber is transferred to the circulating steam by the radiation effect.

In the first flue (see the drawing) are a secondary superheater and, above it, an economizer. In the second flue are the second half of the economizer and, below it, an air preheater, in which the total combustion air is preheated to 475 deg. F. These two boilers will be started shortly. While the former Loeffler boilers were provided with piston steam pumps, the new units have rotating pumps, which, in addition to low investment cost, have the great advantage of smooth motion without shocks.

The operation of these two Loeffler boilers will prove the unexcelled dependability of the system and remove all resistance to its general introduction. C. F. Hirshfeld judges as follows: "I was at first very skeptical about the possible success of the Loeffler principle, but of late I have begun to believe that it contains the possibility of success under American conditions.

The Causes of Wrecked Machinery*

By WILLIAM H. BOEHM
Vice-President
The Fidelity & Casualty Co.

ONE can scarcely pick up an engineering journal without noticing an account of a disastrous machinery accident. Sometimes a little water getting into the cylinder has wrecked an engine or a compressor. Sometimes an accident to or derangement of the governing mechanism has allowed an engine to race and burst its flywheel by centrifugal force. Sometimes excessive vibration or an accidental increase in speed, or a stripping of buckets has wrecked a turbine.

The resulting damage to machinery and buildings is serious, and persons in the path of the flying missiles of iron or steel are killed or injured. The amount of the loss depends upon the size of the machine, the value of the surrounding property, and the number of persons in the immediate vicinity.

The clearance between the cylinder head of an engine and its piston at the end of the stroke is $\frac{3}{8}$ in. or less. The slightest amount of water or condensed steam getting into this space is almost certain to wreck the engine. Sometimes the cylinder head is bumped out. Sometimes the crankpin is broken. The main frame of the engine may be broken in two, or the flywheel canted against the side of the wheel pit and wrecked. Engine accidents also are caused by invisible flaws in the metal or by crystallization of the metal due to repeated bending stresses or by careless or negligent operation.

THE HORSEPOWER of an engine is directly proportional to its speed and to its mean effective pressure. If its speed be doubled its horsepower will be doubled, and this without any increase in the steam pressure. The capacity of its flywheel to prevent sudden fluctuations of speed is proportional to the weight of the wheel and to the square of its speed. If the speed be doubled, only one-fourth the weight will be required to give equally efficient speed regulation. The capacity of a belt to transmit power is proportional to its width and to its speed. If its speed be doubled only one-half its width will be required to transmit the same amount of power. It will be understood from this that a slight increase in speed means a considerable saving in the size and cost of the engine, of its flywheel, and of its belt. Therefore, the temptation to run engines at high speed is so great that they often are pushed to dangerously near the limit of safety.

Flywheels may fail, primarily, from two causes, namely, from overload or from overspeed. In many instances the overload is produced suddenly and causes the wheel to fail either by the torsional strain produced or by the crushing strain due to the pressure of the belt acting against the rim.

Overspeed causes the wheels to explode by centrifugal force. Racing may be produced by slipping or breaking of the governor belt or governor pulley, derangement of the governor by internal or external causes, as well as by other defects. In the case of a condensing engine, racing often continues until the wheel is disrupted, even after the engineer has succeeded in shutting off the steam. Unfortunately, when an engine starts to race the men in charge of machines in the mill shut them down, and the decrease in load causes a further increase in speed until the engine runs away.

Comparing flywheels with boilers, it will be observed that steam is always the primary cause of boiler explosions, while speed usually is the cause of flywheel explosions. It would seem, therefore, as proper to speak of high "speed pressure" as to speak of high "steam pressure."

As a matter of fact, the influence of speed on fly-wheels is much the same as the influence of steam on boilers. Each produces radial forces that exert a tensile stress in the rim of the flywheel, or in the shell of the boiler, as the case may be.

In the case of boilers steam exerts the radial force, acting on the shell of the boiler, and when the steam pressure becomes sufficient the boiler bursts. With flywheels, speed exerts the radial, or centrifugal, force acting on the rim of the wheel, and when the speed becomes sufficient the wheel bursts.

WHILE the influence of speed on flywheels is much the same as that of steam on boilers, it should be borne in mind that when changes of speed and pressure occur, the stresses produced in each case follow entirely different laws.

In boilers the stress in the shell increases proportionally with the steam pressure. Doubling the steam pressure doubles the tensile stress acting on each square inch of the shell. With flywheels the stress in the rim increases with the square of the speed. Doubling the speed quadruples the tensile stress acting on each square inch of the rim.

In boilers any increase in the thickness of the shell allows a proportional increase in the steam pressure that may be carried. But increasing the thickness of the rim of flywheels *does not* increase the allowable speed at which it may be run. The reason for this is that any weight added to increase the thickness of the rim increases the centrifugal force in exactly the same ratio.

For a given material there is a definite speed at which disruption occurs, regardless of the amount of material used. This is not an uncertain theory, but a mathematical truth easily demonstrated, and is expressed by the formula

$$V = 1.63\sqrt{\frac{SE}{W_d}}$$

in which V is the velocity of the rim of the wheel in feet per second at which disruption will occur, W the weight of a cubic inch of the material used, S the tensile strength of one square inch of the material, and E the efficiency of the rim joint, E being 1 for wheels without rim joints.

If, instead of the ultimate tensile strength of the material, its safe strength is used, the result will be the rim speed in feet per second at which the wheel may be run with safety, the supposition being that the wheel is made of homogenous material and is free from shrinkage strains.

Applying the formula to determine the safe rim speed for cast-iron wheels made in one piece, we would assume that, if the ultimate strength of small test bars was 20,000 lb. per square inch, we could depend upon having 10,000 lb. in large castings.

Using a factor of safety of 10 on this would give 1,000 pounds per square inch as the safe strength of this material. The weight of a cubic inch of cast iron being approximately 0.26 of a pound, 100 ft. per second is a safe rim velocity for cast-iron wheels, which corresponds to about 1.15 miles per minute. This would be 120 r.p.m. for a 16-ft. wheel.

Rim joints are a constant source of danger, and should receive careful consideration. Perhaps the importance of looking to the rim joint will be better appreciated when it is remembered that the usual bolted and flanged rim joints between the arms of sectional belt wheels average a strength of only 25 per cent of the solid rim. By placing the joints in such wheels at the ends of the arms, instead of between them, an efficiency of 50 per cent of the strength of the rim may be obtained. The reason for this is that the centrifugal force of the heavy flanges and bolts is then directly sustained by the arms instead of being left free to act as a bending force on the rim.

IN HEAVY, thick-rimmed balance wheels, where steel links are shrunk on to reinforce the joint, an efficiency of 60 per cent is possible, but this construction cannot be supplied to belt wheels having thin rims. A higher efficiency of rim joint can be obtained only by making the rim of the wheel box or eye section.

The casing of a turbine generator may be burst by excessive steam pressure, by temperature stresses, or by stripped buckets that choke the clearance space. The bucket wheels may be burst by excessive vibration due to impaired balance, or by excessive speed due to deranged governor and speed limits.

*Abstract of one of a series of lectures at Rutgers College.

RECENT BIDS ON MACHINERY—Below are three tabulations of bids received by Burns & McDonnell Engineering Company, Kansas City, Mo., upon oil engines, turbine generator and boilers. As these bids are of recent date, the quotations reflect present price tendencies. In the case of the Diesel bids, the quotations include an oil pump and a 10,000-gal. oil tank, but no water pump or cooling tower. As will be seen, there is a remarkable variation in the quotations and on a kilowatt capacity hours the prices are low.

Diesel Engine and Generator for Winterset, Iowa, Municipal Plant

Bidder	A			B		C		D		E		F	
Price of engine, generator exciting, switchboard and auxiliaries	$52,600	$68,000	$44,000	$46,425	$57,455	$37,790[1]	$48,965	$43,625	$43,430	$60,466	$40,275	$67,140	$39,250
Generator rating, kw	500	750	500	500	750	500	750	500	500	750	500	750	500
Type of engine air or solid injection	Solid	Solid	.....	Air	Air	Air	Air	Air	Air	Air	Air	Air	Solid
Stroke-cycle	4	4	4	2	2	4	4	4	4	4	4	4	2
Brake horsepower, sea level rating	750	1,125	675	800	1,075	720	1,060	865	810	1,080	750	1,200	750
Number of cylinders	4	6	6	6	8	5	8	6	6	8	6	6	5
Cylinder diameter, in.	22	22	17	14¾	14¾	17½	17½	17½	18	18	17½	23	16
Stroke, in.	30	30	24	18	18	25	25	25	25	25	24½	26	20
R.p.m.	180	180	240	277	277	225	225	225	225	225	225	200	257
Regulation, no load to full load, per cent	3	3	3	6	6	3	3	3	3	3	3	3	5
Concrete for foundation, cu.yd.	167	200	120	105	115	97	121	109	115	130	103	175	90
Total weight, engine, generator and exciter, lb.	240,000	312,000	181,000	165,500	140,500	180, 520	252,400	202,720	244,000	296,000	181,600	293,000	135,000
Number of air-starting tanks	3	3	2	2	2	2	2	2	1	1	1	1	2
Capacity auxiliary fuel tank, gal.	200	200	150	105	105	100	200	200	175	175	250	250	625
Capacity lubricating oil tank, gal.	200	200	150	650	650	500	750	500	.....	.....	300	450	200
Quantity of 85-deg. water required, g.p.m.	150	225	175	375	500	91	112	109	200	200	325	520	175
Fuel per electric Kw.-Hr., full load, lbs.	0.62	0.62	0.63	0.67	0.67	0.645	0.63	0.64	0.607	0.605	0.605	0.60	0.60
Three-quarter load	0.62	0.62	0.63	0.71	0.71	0.66	0.64	0.655	0.626	0.622	0.635	0.631	0.635
Half load	0.68	0.68	0.69	0.81	0.81	0.714	0.69	0.705	0.710	0.705	0.70	0.695	0.695
Quarter load	.....	.....	.....	.....	.....	.....	.....	.....	1.00	0.995	.....	.....	1.03

[1] Contract awarded. Fuel Consumption Guarantees Based on 18-22 Deg. Baumé Gravity Oil, 18,500 B.t.u. Effective Heat Value per pound

Power Plant Equipment for Columbia, Mo., Municipal Light Plant

Bidder	A		B		C		D		E		F		G		H	
Furnishing and installing complete two 6,000 sq.ft. water tube boilers, with superheaters, chain-grates, fans, brick and air cooled setting, soot blowers and regulator	$84,000		$73,500		$65,180		$58,500		$73,980		$67,506		$76,948		$74,875	
If city desire to furnish and install the air-cooled walls and brickwork deduct	$14,500		$15,400		$14,700		$7,500		$14,398		$16,340		$18,000		$17,040	
The following specifications describe the proposed equipment:																
Boiler																
Working pressure, lb.	250		250		250		250		250		250		250		250	
Heating surface, sq.ft.	5,953		6,025		6,000		6,025		6,000		6,000		6,050		6,170	
Number of drums	1		1		2–48 in.x22 ft.		1		1		2–42 in.		1		3	
Number and size of tubes, in.	280–4		270–4		332–3½		391–3½		332–3½		299–4½		420–3		308–4	
Width of setting, ft.	12		14		15		14		15		14		17		17	
Superheater																
Size header, in.	7¼		8		8		8		8		8		8		8	
Tubes, in.	.....		1¾		.....		1¾		8		1¾		1¾		.....	
Per cent rating	150	200	150	200	150	200	150	200	150	200	150	200	150	200	150	200
Degree superheat, deg. F.	129	147	130	153	130	145	130	153	130	145	130	153	150	153	125	145
Pressure drop, lb.	2.5	4.0	2	4.5	1.4	2.4	3	7	1.6	2.8	3	7	2	4.5	1.1	2.4
Stoker, Chain Grate																
Projected area, sq.ft.	127.5		150		150		150		143		150		142		.....	
Per cent rating	150	200	150	200	150	200	150	200	150	200	150	200	150	200	150	200
Stoker hp. required	2.2	2.5	2.00	2.25	2.00	2.25	2.00	2.25	1.50	1.75	2.00	2.25	1.4	1.5	2.00	2.25
Furnace efficiency	75	74	75	74	75	74	75	74	76	75	.....	.....	74.5	74.5	1.50	1.80

Turbine-Generator, Surface Condenser and Switchboard at Winterset, Iowa

Bidder	G		H		I		J		K		L		M		N	
500-kw. turbine-generator with switchboard	$44,906.00		.....		$19,085.00		$18,400.00		.....		$19,416.00		.....		$19,141.00	
750-kw. turbine-generator with switchboard	$53,026.00		.....		$23,925.00		$22,743.00		.....		$23,066.00		.....		$23,091.00	
Surface condenser with condensate pump, air pump, and auxiliaries for 500-kw. generator	.....		$6,525.00		$6,900.00		$4,550.00		$4,030.00		.....		$6,345.00		$5,065.00	
Surface condenser with condensate pump, air pump, and auxiliaries for 750-kw. generator	.....		.....		.....		$7,725.00		$4,820.00		.....		$8,250.00		.....	
Erection superintendent, per day	.....		$25.00		$15.00		$18.00		$18.00		$20.00		$16.00		$18.00	
Guaranteed Steam Consumption per Kilowatt-hour, 250-lb. 150-Deg. Initial Steam and Vacuum of 27.5 In.																
Turbine, kw.	500	750	500	750	500	750	500	750	500	750	500	750	500	750	500	750
1¼ load (100 per cent p. f.)	15.1	14.6	.....	.....	15.4	14.8	15.2	14.9	.....	.....	16.10	15.50	.....	.....	15.1	14.6
Full load (80 per cent p. f.)	15.4	14.8	.....	.....	16.1	14.6	15.2	14.9	.....	.....	15.45	14.65	.....	.....	15.4	14.8
¾ load (80 per cent p. f.)	16.0	15.22	.....	.....	16.9	14.5	16.1	15.8	.....	.....	16.20	15.10	.....	.....	16.0	15.22
½ load (80 per cent p. f.)	17.64	16.54	.....	.....	19.3	16.0	17.6	17.1	.....	.....	17.60	16.10	.....	.....	17.64	16.54
¼ load (80 per cent p. f.)	22.5	20.5	.....	.....	25.6	20.2	20.7	19.4	.....	.....	22.0	19.25	.....	.....	22.5	20.5
Condenser																
Cooling surface, sq.ft.	800	1,140	1,000	1,500	1,000	1,500	1,000	1,500	675	1,000	.....	.....	1,000	1,500	800	1,140
Water velocity through tubes, ft. per sec.	6.08	6.00	5.35	6.16	5.97	6.43	7.22	7.3	7.3	7.22	.....	.....	5.88	5.73	6.08	6.00
Friction loss through condenser (inlet to outlet), ft.	10.67	10.6	5.13	11.48	11.5	15.0	13.0	13.0	13.0	13.0	.....	.....	9.0	8.6	10.67	10.6
Circulating Pump																
Gal. per min.	925	1,300	1,300	1,900	1,175	1,550	1,300	1,900	1,075	1,600	.....	.....	1,300	1,900	925	1,300
Air Pumps and Inter-After Condenser																
Capacity dry air at 70 deg. F. and 2 in. absolute pressure, lb. per hr.	16.44	16.44	.....	.....	6.6	7.1	6.0	9.0	6.0	9.0	.....	.....	8.3	8.3	16.44	16.44
Steam per hour 250 lb. and 150 deg. superheat	316	316	117	117	140	150	110	205	110	205	.....	.....	140	140	416	316
Generator Air Cooler																
Cooling surface, sq.ft.	278	326	.....	.....	.....	.....	290	428	.....	.....	375	500	.....	.....	278	326
Water required, g.p.m. at 55 deg. F.	18	22.4	.....	.....	.....	.....	6	9	.....	.....	30	30	.....	.....	18	22.4

THE ENGINEER'S B

The Engineer's Answer

TOWARD CIVILIZATION. *Edited by Charles A. Beard. Published by Longmans, Green & Company, 55 Fifth Ave., New York City; 1930. Cloth, 5½ x 8½ in.; 307 pages. Price, $3.*

SOME TIME AGO Professor Beard asked a group of lawyers, economists and philosophers for an appraisal of our modern machine civilization. Their opinions, published in "Whither Mankind," showed that while some saw in it the possibilities of a richer physical existence, the majority viewed with alarm its effects on the emotional, mental and spiritual life of man. They were, as Professor Beard points out, the findings and impressions of "outsiders looking in." Now the question has been put to the "insiders"—the scientists and engineers responsible for the development of the machine world—and the present volume is their answer.

The new technological civilization has gone so far, says Professor Beard in his introduction, that "imagination is not powerful enough to draw a picture of the new chaos that would follow the disappearance of science and engineering." It is, nevertheless, "under general indictment as the foe of all values, human and divine." It is charged with "quantifying" life, with "mechanizing" the human soul to the verge of extinction, and with producing a "morality of material utility and success."

And what is the engineer's answer? It is evident from this symposium that the engineer recognizes the peculiar position of superiority which he occupies in the modern world. His reply, however, comes without arrogance, without coldness, but with humility and a warm appreciation of human values. He is not blind to "the evils and maladjustments connected with the development of science and engineering." Rather he sees them as problems to be solved in the evolutionary process of life itself. While he recognizes his great responsibility, he is convinced that many of the criticisms of the "machine" are in reality criticisms of fragments of an obsolete culture that still survives.

As C. F. Hirshfeld points out, "the young giant power has opened vistas of progress, of accomplishment, of improvement, of real worth that are both intriguing and inspiring. It remains to be seen whether humanity in mass is capable of using advantageously such rich opportunities . . . But, at least, we need not side unquestioningly with the pessimists because we do not observe on the part of newly liberated masses an immediate rush to higher cultural forms instead of the obvious satisfaction of much more lowly appetites and aspirations." The machine may be new, but selfishness and stupidity are as old as the human race.

In bringing out her idea of life as a unified activity with the avowed purpose of moving upward, Lillan M. Gilbreth says, "There is no fundamental difference of opinion between the engineer and his critic—both desire for every man a full and free expression of all that he has to express."

And writing on spirit and culture under the machine, Harvey N. Davis points out that we "must never forget that the spirit and culture of the future are going to depend primarily on what is inside men and women rather than on what is about them, that the greatest need is for sound and wide-spread education and for real intellectual leadership, and that, with these, no plethora of machines can either cause, or prevent, the flowering of the best that human minds are inherently capable of producing." Machines will rather serve as a tool to accomplishment of man's greatest purpose in life.

These same thoughts—the unpreparedness of the great mass for the new civilization, the inspiring appreciation of and desire for the good life for all, and the belief that the "scientific method" offers a means to the attainment of the larger—run, in part, through the other contributions, by Ralph E. Flanders, Robert A. Millikan, Elmer A. Sperry, Roy V. Wright, Lee de Forest, Dexter S. Kimball, Thomas D. Campbell, L. W. Wallace, Richard F. Bach, Stephen F. Voorhees, Ralph T. Walker, William E. Wickenden and Michael Pupin. As Professor Beard so finely expresses in his summary:

"It is difficult to discover any value ardently desired by the critics of machine civilization which these engineers and scientists do not likewise desire. Is it leisure? They propose to make it more universal. Is it the good life? They will provide the necessary material conditions to make it more abundant. Is it beauty? They insist upon fostering the love of it and incorporating it into the daily lives of millions. Is it truth? They propose to pursue it, not merely within the confines of historical categories but wherever it may lead in this mysterious world of substance and power. It is anything covered by the term humanity—fair dealing, toleration, freedom from pain and suffering, relief of misery, succor for them that are hungry and athirst, aid for the weak and afflicted, guidance for the stumbling? They propose to use the engines of science and invention to fortify, speed up and multiply the agencies of humanity."

No one can read this volume without coming to a fuller and more sympathetic understanding of the engineer and his work. His answer shows an intense faith in his method and a fine appreciation of what he has wrought. That he is as yet only dimly aware of the spheres beyond the material existence of this earth is no reason to condemn him. He is, after all, a human being with all the potentialities which that implies.

Welding Reference

THE WELDING ENCYCLOPEDIA. *Seventh Edition, compiled and edited by L. B. Mackenzie and H. S. Card. Published by The Welding Engineer Publishing Company, 608 South Dearborn St., Chicago, Ill. 540 pages; 670 illustrations; flexible imitation leather binding. Price $5.*

AFTER 200 pages devoted to definitions and discussions of words and terms used in welding literature, the authors discuss gas, arc, resistance and thermit welding, including instructions for welding all of the commercial metals by each of these processes. Separate chapters are given over to such important applications of welding as pipe, tanks, boilers and structural steel. The subject of cutting and the subject of training operators also have separate treatments.

In the new edition extensive additions have been made to include up-to-date information on some of the newer applications of welding, such as aircraft welding, welding of machine parts, and structural steel welding. Other important additions to the previous edition deal with the welding of special alloy steels and the welding of non-ferrous metals and their alloys.

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Laboratory Manual

MECHANICAL ENGINEERING LABORATORY PRACTICE. *By Charles F. Shoop, professor of steam engineering, University of Minnesota, and George L. Tuve, professor of mechanical engineering, Texas Technological College. Published by McGraw-Hill Book Company, 370 Seventh Ave., New York City, 1930. Cloth, 6x9 in.; 488 pages; illustrated; numerous forms and tables. Price, $4.*

DESIGNED specifically to guide the engineering college student in his laboratory work, in this book the usual range of subject matter is covered, divided into sections for mechanical measurements, methods and instruments, miscellaneous exercises, friction and lubricants, heat and heat transfer, properties of gases and vapors, measurement of fluid flow, pumps and compressors, steam power generating units and auxiliaries, automatic regulation, refrigeration, and internal combustion engines.

There are two antagonistic theories of laboratory instruction. At one extreme is the instructor who believes in giving the student detailed instructions, lists of instruments required, forms to be used, etc. The opposite view is that the upper-class student at least should

BOOKSHELF

be given practically no instructions beyond, "Test that pump," or the equivalent. Proponents of guidance argue that the method of individual initiative results in lost movement and aimless groping. Proponents of the individual initiative system, on the other hand. say that excessive regimentation of students eliminates the necessity of thinking and leaves the graduate poorly fitted to attack original problems. This book stands at neither extreme, but does lean definitely toward systematic control of the student's work.

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Electricity Simplified

ARITHMETIC OF ELECTRICITY. *By T. O'Connor Sloane. Published by the Norman W. Henley Publishing Company, 2 West 45th St., New York City, 1930. Cloth; 5 x 7 in.; illustrated; 17 tables; 230 pages. Price, $1.50.*

IN THIS little book the mathematics of electricity have been presented in a simplified form. Most of the computations have been presented in simple arithmetic. Many problems are worked out to show how the method of calculation is applied. These calculations include Ohms law problems, alternating and direct current; generators and motors, railways, and feeder networks.

In working the problems through by simple arithmetic, it has been the author's purpose to lead the student through an analysis of the problems rather than give him a short-cut method. Where it is practical, formulas have been inserted at the end of the explanation, but for the most part the examples are done without using algebra. The one exception to this is the chapter on networks, in which simple algebra has been used extensively. For those wishing to improve their knowledge of the simple principles involved in a study of electricity, this little book will prove helpful.

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Standardized Wiring

INDUSTRIAL ELECTRICITY AND WIRING. *By James A. Moyer and John F. Wostrel. Published by McGraw-Hill Book Company, Inc., 370 Seventh Ave., New York City, 1930. Cloth; 5½x8 in.; 469 pages 281 ilustrations, 40 tables. Price, $2.75.*

THIS IS a book on wiring for power and lighting based on the national electrical code. From start to finish reference is made to the code as authority for the practices recommended. This method of presentation has much in its favor, as the national electrical code is the generally accepted standard of electric wiring, and every student aspiring to do electrical work should be familiar with it.

Fundamental theory and electric units are treated in the first chapter. The remaining eighteen go into the practical phases of wiring of electrical equipments and their connections. Some of the subjects covered are: Details of wiring in conduit and moulding; wiring old buildings, and unit costs; industrial electric motors and motor wiring; industrial lighting; estimating industrial and house wiring; and an appendix gives estimated demand factor for buildings. Owing to the confusion resulting from the numerous code rules in regards to grounding, the authors have devoted one chapter to a summary of the code rules on this subject.

The book is for vocational students and those who wish to familiarize themselves with the underlying principles of electrical equipment and circuits and with standard methods of electrical construction. The text is presented in a form that can be understood by those who do not have a technical education. Only the simplest theory is touched upon, and that in a practical way.

European Hydro Progress

WASSERKRAFT-JAHRBUCK 1928/29. *Water Power Annual. Published by Hirth Verlag A.G., Herrnstr. 4-10, Muenchen, Germany. Cloth, 6 x 9 in.; 487 pages, 223 illustrations. Price RM. 22-.*

DR. ING. K. DANTSCHER and Ing. Carl Reindl, both of Muenchen, are responsible for the fourth "Water Power Annual." This most interesting book contains 33 articles by eminent experts of different countries covering, broadly: the status of water power in Austria, Italy, France, Norway, Finland, Iceland, Czechoslovakia and Greece; also, the legislation, research institutions, surveys concerning this question. The third part contains four highly technical articles and a study of power house architecture in respect to the landscape. The fourth part deals with water turbines; seven excellent articles embrace erosion, cavitation, vibration, speed regulation and balancing of the wheels.

These water-power annuals bid straight to become in their line what Lord Brassey's annuals were to the navies of the world, and their informative value would be greatly enhanced if a series of comprehensive tables for every country were given showing data of the most important plants, built and being built, as well as the total potential and developed power by sites.

The book is well printed and illustrated and will be of utmost interest to all concerned in water-power development.

N. C. ARTSAY.

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Brief Reviews

A STUDY OF CIRCUMFERENTIAL BENDING OF PIPES AND CYLINDRICAL CONTAINERS. By Raymond J. Roark, Bulletin 69 of the University of Wisconsin engineering experiment station, Madison, Wis., 1929; 48 pages, illustrated; price, 75 cents—This bulletin presents the results of a partial analysis of the circumferential bending movements produced in horizontal thin cylinders filled with liquid and supported in various ways, and of the bending moments produced in the rings used to stiffen or support such cylinders.

PRACTICAL POINTERS ON THE SELECTION OF MOTOR CONTROL. By W. H. Costello. Published by Cutler-Hammer, Inc., 12th and St. Paul Ave., Milwaukee, Wis.; 32 pages; illustrated; free.—This booklet contains four articles, reprinted from *Power* giving practical tips on the proper selection, installation and maintenance of electric motor control in various industries.

PROCEEDINGS OF THE THIRD IOWA POWER AND INDUSTRIAL CONFERENCE. Published by the University of Iowa, Iowa City, Iowa. Bulletin No. 239; 208 pages, paper; price $1.—A complete transcription of the proceedings of the Iowa Power and Industrial Conference held at the University of Iowa in April, 1929, this publication contains much valuable information on the generation and use of power in connection with Iowa industries.

KOHLENSTAUBFEUERUNGEN: ZWEITE AUFLAGE. By Hermann Bleibtreu. Published by Verlag von Julius Springer, Berlin, Germany, 1930. Cloth, 495 pages, illustrated.—A detailed treatise on the latest American developments in the design and use of pulverized-fuel equipment, written in German by an engineer of the Freyn Engineering Company.

CORRECTION — V.D.I. — Verlag G.M.B.H., Berlin N.W. 7, Germany, calls our attention to the fact that their books — THE MULHEIMER WORKS OF SIEMENS-SCHUCKERT COMPANY and RESEARCH—listed as free in our issue of March 4, sell for RM 10 and RM 6 bound, and RM 4.50 each stitched.

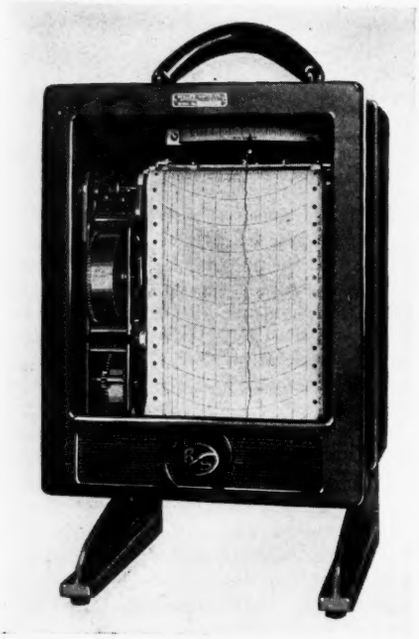
WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Graphic Instruments for Alternating and Direct Current

ACCESSIBILITY is an important feature of the type AG and type DG graphic instruments for alternating and direct current recently brought out by the Roller-Smith Company, 233 Broadway, New York City.

The clock, chart and electrical mechanisms are mounted on a common sub-base hinged on one side of the main base. This sub-base can be unlatched and swung outward, making it possible to readily inspect the complete operating mechanism. The front cover, which is held by two hook hinges at the top, and tightened in place by a bolt at the bottom, is also readily removed for the insertion of new rolls, filling of inkwells and other adjustments.



Type AG graphic voltmeter portable model

The direct-current ammeter and voltmeter mechanisms are of the high torque d'Arsonval type, and the alternating-current movements are of the dynamometer type. All alternating-current ammeters and wattmeters are of 5 amp. capacity and are designed for operation with standard current transformers.

Other features include a type of pen that is readily removed and an inkwell that is removable by simply turning a lever, or it may be filled without removing it from the holder or without disturbing the setting of the pen or other part.

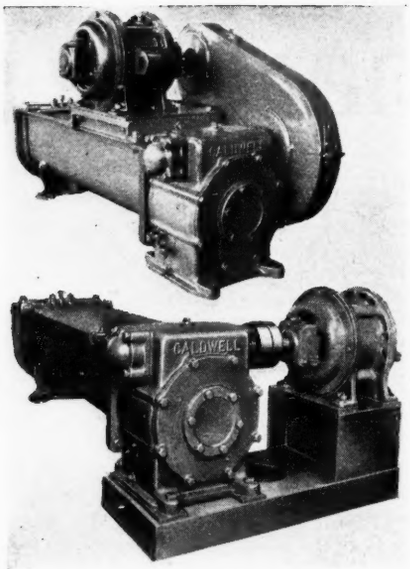
All instruments are furnished with gears for five speeds, namely, $\frac{3}{4}$, $1\frac{1}{2}$, 3, 6, and 12 in. per hour. They have a strip type of chart, 5 in. wide, with $4\frac{1}{2}$-in. scale, and are available in switchboard, wall and portable designs.

Standardized Drives for Screw Conveyors

MADE in two types, C and D, the standardized drives for screw conveyors recently announced by H. W. Caldwell & Son Co., division of the Link-Belt Company, Chicago, Ill., are suitable for conveyors from 8 to 16 in. diameter.

Type C drive consists of a silent chain fully inclosed in an oil-retaining steel casing, and a worm-gear speed reducer designed to serve as a thrust-end and screw conveyor drive.

Type D drive consists of a direct-coupled reducer, mounted with its motor on a unit base plate. This type of drive permits the selection of a worm-gear reducer according to horsepower rating, without regard to the size of the conveyor.

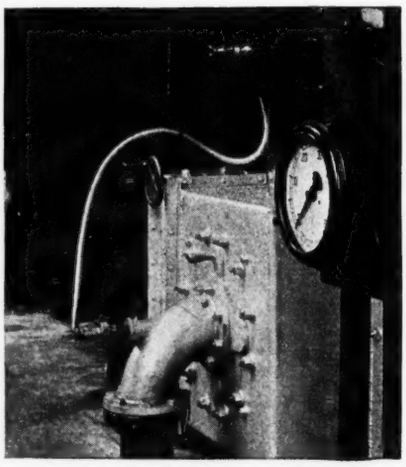


Types C and D drives for screw conveyors

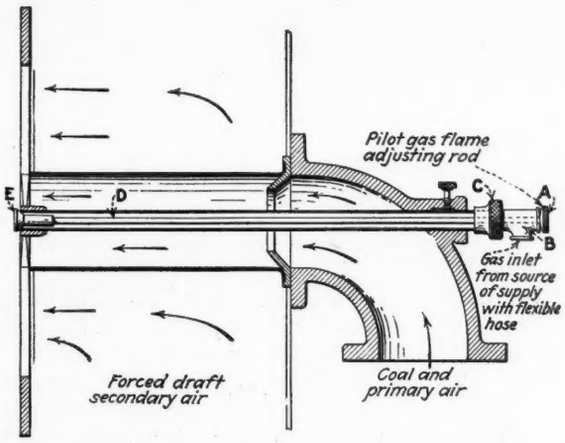
All of the reducer bearings on both types are anti-friction, with automatic lubrication. Oversize bearings on the worm-gear shaft take the conveyor end thrust in either direction. The drives illustrated are adaptable to horizontal or inclined conveyors, with proper adjustment of the oil levels. Standard motors of 860 or 1,160 r.p.m. (60 cycle), and 710 or 1,430 r.p.m. (25 cycle) can be accommodated on these conveyor drives.

Pilot Gas Igniter for Pulverized Fuel Burners

IN MANY pulverized-fuel installations, except where a burner for pulverized coal in combination with



Front view of burner fitted with igniter



Gas for igniting the pulverized coal passes through central pipe used to adjust flame spreader

oil or natural gas is used, the usual methods employed of igniting the pulverized fuel are more or less hazardous owing to the possibility of retarded ignition and blow back.

To preclude this occurrence and to provide a safe and convenient method of igniting pulverized fuel where gas is available, the igniter illustrated has been developed by Peter Dias, 123 38th St., Irvington, N. J. The igniter, which consists, essentially, of five parts as indicated by the letters *A, B, C, D* and *E,* is shown incorporated in a Riley flare-type burner arranged for horizontal firing. It can, however, be applied to practically any type of burner.

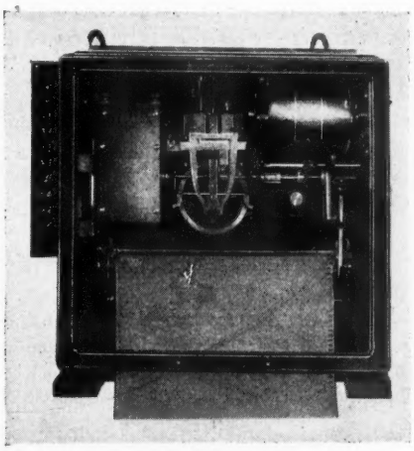
In the particular burner illustrated the gas tube is inserted in the center of the coal spreader pipe and the gas tip or spreader *E* is made adjustable by means of a central rod *D* and knurled nut *A,* the spreader being adjusted to produce a flame of sufficient area to completely cover the end of the coal discharge pipe. The knurled nut *C* is used to adjust the fuel spreader and flame requirements of the pulverized-coal burner. When the coal has become properly ignited the gas is shut off and the gas spreader *E* is drawn closed. The gas connection to the igniter is made by a flexible armor-clad hose at the tee *B* attached to the end of the coal-spreader adjusting pipe, as shown.

Direct-Reading Humidity Recorder

AS IN THE ordinary psychrometer the basis of the measurement, in the direct reading humidity recorder illustrated, is the difference in temperature of wet- and dry-bulb thermometers in a current of air. This new instrument, however, eliminates entirely the necessity for any reference to a table or chart, as is necessary with the ordinary apparatus.

The complete equipment comprises two separate electrical units, one designated the wet- and dry-bulb apparatus and the other the recorder. These are connected together by suitable electrical conductors and may be placed any reasonable distance apart.

The wet- and dry-bulb apparatus comprises two similar electrical resistance thermometers mounted in a tunnel through which a stream of the air under test is drawn by a small exhaust fan. Provision is made for keeping the surface of one of the thermometers wet by means of a wick. The air stream is made to flow through the tunnel at a velocity sufficient for constant evaporation from the wet bulb in any condition of air temperature and humidity.



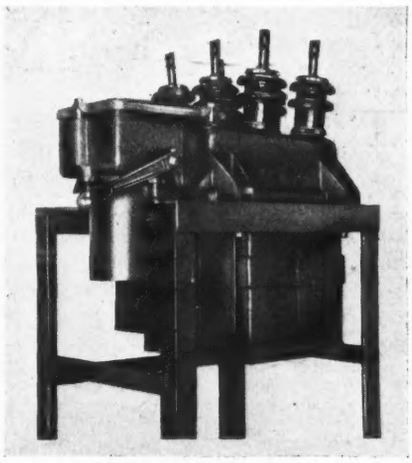
Recorder draws continuous curve of relative humidity

The recorder draws a continuous curve on a chart 10 in. wide, with a scale reading directly in relative humidity from 20 to 100 per cent. The chart is moved forward at a rate of $1\frac{3}{8}$ in. per hour. Power for operating the instrument is supplied by a 110-volt 60-cycle synchronous motor.

This instrument is put out by the Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

Oil Circuit Breaker for Outdoor Service

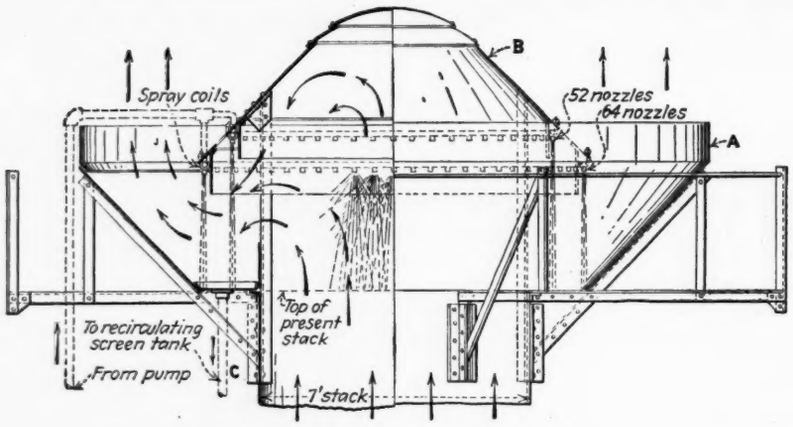
TYPE FO-22 oil circuit breaker recently brought out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is intended specifically for outdoor service and will remain absolutely weather-proof under the most severe weather conditions. It is available in two- and three-pole single-throw sizes, in capacities of 400, 600 and 800 amp., for operating voltages of 7,500 or less and with an interrupting capacity of 3,500 amp. at 7,500 volts. The breaker is designed primarily for pipe or structural steel framework mounting, but can be adapted to wall or pole mounting. It is arranged for either manual, direct-current solenoid or alternating-current solenoid (direct-current solenoid—Rectox combination) operation. The Rextox is housed in a weather-proof transformer case that can be mounted at any point conveniently close to the breaker.



Type FO-22 circuit breaker

The automatic breaker is mechanically trip-free at any point of the closing stroke and can be equipped with the following attachments: A maximum of three series trip attachments, having inverse time-limit features; three transformer trip attachments having instantaneous, inverse time-limit or direct-trip features; a shunt-trip attachment; a low-voltage release; a counter; and a four- or a six-pole rotary-type auxiliary switch.

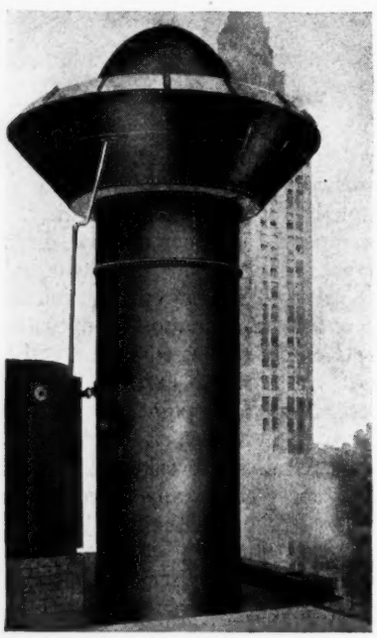
An external mechanical position indicator shows the contact position regardless of the position of the operating handle or solenoid plunger. The auxiliary switches are in a separate chamber, and are isolated from the expansion chamber by an oil- and gas-tight wall.



Partial cross section through "washer"

Washer to Remove Fly Ash, Soot, and Fumes From Boiler Gases

THE principal disadvantage of a short stack on a power plant or other building where the top of the stack must necessarily be only a short distance above the roof, is the tendency for the fly ash and soot from the flue gases to collect on the roof, filter in through windows and doors and precipitate generally over the immediate vicinity. This discharge of fly ash from coal-fired plants and soot from oil-fired installation, as well as the sulphurous fumes common to both, is particularly objectionable on public structures, such as hotels, office buildings, etc.



Typical installation on a hotel stack

With a view to overcoming this trouble, by providing a means of removing the objectionable waste products from the gases, the down-jet, spray-type washer illustrated has been brought out by the American Smoke & Soot Washer Company, Inc., 55 West 42d St., New York City. A typical installation and a cross-section of the washer are shown in the illustrations.

From a study of the cross-section, the details of the washer will be clearly understood. An inverted cone section *A* is fastened to the top of the existing stack, with a dome-shaped canopy *B*, slightly larger in diameter than the stack, supported centrally above it. On the inner side and near the lower edge of the canopy *B* are attached two spray coils as shown. Each coil is fitted with a sufficient number of flat spray-type nozzles to produce a thin, circular curtain of water completely surrounding the stack.

The path of the gases through the washer is indicated by the arrows, and it will be seen that in passing from the stack to the atmosphere the gases must pass through two curtains of water, the velocity of the water leaving the nozzles and the complete curtain formed by it serving to throw down the particles of fly ash and soot as well as remove the sulphurous fumes. To prevent any gas escaping between the nozzles or above the curtain, circular baffles are placed directly inside the spray coils.

As the washer must necessarily be located a considerable distance above the point of water supply to the building, a motor-driven centrifugal pump is generally used to maintain the pressure (20 to 30 lb.) on the spray coils. The drain from the spray, as at *C*, is led to a recirculating screen tank, where, by means of screens and baffles, the solid particles are precipitated and the water is recirculated through the nozzles by the pump. With this arrangement a constant pressure is maintained on the spray coils and a minimum amount of water is used to do the washing, the only labor involved being the removing of the solids from the tank at intervals and the cleaning of the screens from time to time. An opening is provided in the canopy *B* directly opposite each nozzle, so that the operation of the nozzles in the upper coil may be seen from the walkway which surrounds the cone-shaped section *A*.

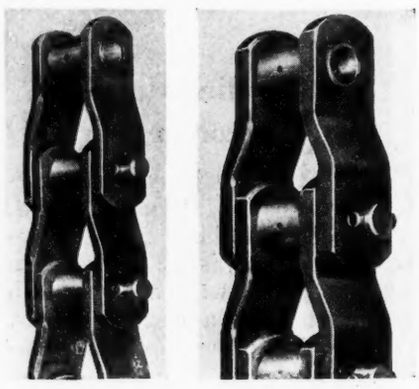
To keep corrosion at a minimum, copper spray coils with tobin bronze nozzles are used, and the plate construction is of a highly acid-resisting metal, the whole being protected by several coats of a preserving paint.

With a slightly modified construction the washer is equally well adapted to brick as to steel stacks.

Roller Chain for Heavy Duty

TO MEET a growing need for a stronger and more durable type of chain for heavy positive power transmission, the Link-Belt Company, Indianapolis, Ind., has developed a new steel drive chain designated by the trade name "Hyper." The chain is made from alloy steel, heat treated, and uses a new type of pin and cotter. The pins, bushings and holes in the side bars are accurately ground, insuring good fits and giving a chain construction that combines great strength with durability. The cotters are of a special type designed so as not to work loose when once inserted and swelled into the holes provided in the pins. The SS-40 chain has an ultimate strength of 75,000 lb. and the SS-124 chain an ultimate strength of 150,000 pounds.

Two types of heavy-duty power transmission chain



SS-40 chain SS-124 chain

NEWS of the FIELD

Spot News

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CONTRACTS *underwriting the entire power capacity of Boulder Dam according to the allocation published in Power for April 1 were signed last week by California groups. To get the first work under way as soon as possible, Congress will probably have been asked to appropriate at least $10,000,000, before this appears in print.*

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RETENTION *of the present system of handling the field work of the Federal Power Commission was advocated April 29 at hearings on the Parker bill for reorganization of the commission. Sentiment against setting up an independent organization was based on alleged duplication and interference with the work of existing departments.*

•

EXTENSION *of the natural gas pipe lines and distributions of the Southeast, involving an expenditure of more than $15,000,000, was announced April 30 by the Southern Natural Gas Corporation and affiliated companies.*

•

TWO TRANSFORMERS, *which for two seconds have a capacity of 1,250,000 kva., have been installed at the Schenectady works of the General Electric Company. Normally rated at 33,333 kva., they will be used with a 100,000-kva. generator and are the largest yet built for testing work. They will be employed for testing switchgear of various types.*

•

A NEW PROCESS *of extracting helium from natural gas that reduces its price to $35 a thousand cubic feet was announced last week by the Helium Company of Louisville, Ky. Briefly, the process consists of purifying natural gas, compressing it and running it through a single cycle, where highly pure helium emerges under the required pressure for filling cylinders and shipping.*

A.S.M.E. Announces Technical Program for Spring Meeting, June 9-12

Public hearing on power test code, feed-water studies, industrial power, central station and fuels papers are features of Detroit sessions

ANNOUNCEMENT has just been made of the tentative program for the semi-annual meeting of the American Society of Mechanical Engineers to be held at the Book-Cadillac Hotel in Detroit, Mich., June 9 to 12. In all, fourteen technical sessions will be held, of which five will be devoted to subjects directly in the power field.

A feature of the meeting will be the public hearing on a Test Code for Complete Steam-Electric Power Plants, scheduled for Monday morning, June 9. The Power Test Codes Committee is particularly anxious to receive comment on the tentative draft of this code, and it is hoped that all those interested will submit criticism at the hearing or send their written opinions in to C. B. LePage, secretary of the committee, at A.S.M.E. headquarters.

A session devoted to boiler feed-water studies will be held on Monday afternoon, at which papers will be presented on "Electrical Conductance Measurements of Water and Steam and Application in Steam Plants," by Max Hecht and D. S. McKinney, and "Fractures in Boiler Plates," by A. E. White and R. Schneidewind. At the industrial power session on Tuesday morning papers will be given on "Tests of the Resistance of Forged, Riveted and Welded Boiler Shells to Repeated Pressure," by H. F. Moore, and "Boiler Settings for Burning Refuse Wood," by Charles S. Gladden.

On Wednesday morning at the fuels and power session William O. Renkin will present a paper on "Dry Quenching of Coke," and J. W. Mackenzie will deliver one on "Recovery of Fly Ash From Pulverized-Fuel Stacks by Use of Stack Sprays." Papers scheduled for the central station power session on Thursday morning include "Comparative Performance of a Large Boiler Using Oil and Natural Gas Fuels," by Frank G. Philo, and "Comparative Performance of a Pulverized-Fuel-Fired Boiler Using Bin System and Unit System of Firing," by A. E. Grunert.

Besides the power sessions, there will be meetings devoted to applied mechanics, machine shop practice, properties of metals at elevated temperatures, printing industries, wood industries, management, mechanical springs, aeronautics, and education and training for the industries. Some of the papers of interest to power engineers at the properties-of-metals session on Monday morning are "Flow Characteristics of Special Fe-Ni-Cr Alloys and Some Steels at Elevated Temperatures," by H. J. French, William Kahlbaum and A. A. Peterson; "Flow Characteristics of Some Lead Cable Sheath at Temperatures Above Atmospheric," by C. L. Clark and C. Upthegrove; and "An Apparatus for the Determination of Creep at Elevated Temperatures," by A. E. White, C. L. Clark and L. Thomassen.

The program includes a full complement of entertainment features, with a reception and dance on Monday evening; inspection trips, a smoker for the men and a bridge party for the ladies on Tuesday afternoon and evening; a boat trip on the river, taking all afternoon and evening on Wednesday; and an inspection trip to the Ford airport and Crosse Isle airport.

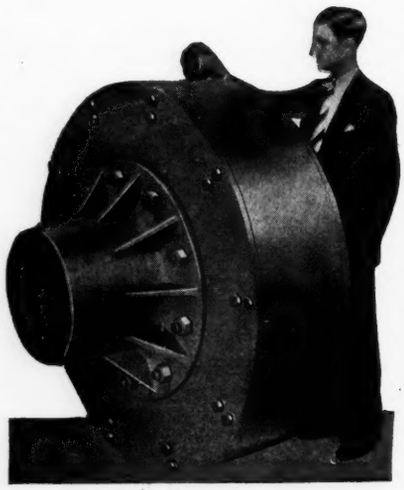
I.E.C. Plenary Meeting in Scandinavia, June 27-July 9

Two days after the adjournment of the World Power Conference in Berlin, Germany, the International Electrochemical Commission will convene at Copenhagen, Denmark, for the opening of its seventh plenary meeting. From June 27 to July 9 members and delegates of the commission will visit power plants, factories and points of interest in Denmark, Sweden and Norway. Technical sessions will be held at Stockholm, Sweden, and Oslo Norway. Entertainment features of the program include many banquets and sight-seeing trips.

Subjects for discussion at the technical meetings include: Nomenclature, Rating, Symbols, Hydraulic Turbines, Steam Turbines, High-Voltage Insulators, Insulating Oils, Overhead Lines, Measuring Instruments, Rating Rivers, Oil Switches and Internal-Combustion Engines. Practically every civilized country in the world will be represented at the sessions, either through delegates or papers presented.

Largest Flexible Coupling Installed on Diesel Drive Dredge Pump

WHAT is believed to be the largest flexible spring coupling of its type ever built—the outside diameter being 59 in. and the weight 4½ tons—was installed recently on the diesel engine drive of a dredge suction pump on the Standard Dredging Company's "New York." The springs, which are of the helical type so that the deflection and stress can be predetermined accurately, are placed in two rows, one in the driving half and one in the driven half, and a floating rim is used to transmit the load from one row of springs to the other. Another feature is the supporting of one half of the coupling in the other so that excessive misalignment cannot develop. The illustration shows Engineer J. W. Baugher holding the smallest Westinghouse-Nuttall coupling on top of the largest.



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Roosevelt Vetoes Contract and Valuation Bills

Governor Roosevelt of New York vetoed on April 27 the Thayer bill amending the public service commission law in relation to a state-wide valuation by the commission of public utility properties. He also vetoed the Thayer bill in relation to rate contracts between municipalities and utility companies.

Commenting on the first of these, he said, "I am disapproving the bill because it tends simply to perpetuate the present valuation muddle, which all agree renders effective regulation impossible. It is distinctly contrary to the proper principles of valuation, and if actually and literally carried out it would in all probability produce higher rates than those which now burden consumers of public utility services." As finally passed the bill was amended so that valuations would be made only at the discretion of the commission.

Of the second bill the Governor said, "Nothing indicates more clearly the utter futility of the [utility] bills passed by the Legislature than this ridiculous bill, which provides merely for optional contracts between municipalities and the utility companies which serve them. Such contracts may be made, with the approval of the commission, providing that for ten years rates shall be adjusted in accordance with the excess of revenues over and above all necessary costs, including depreciation and return on the value of the property." He maintained that no utility or wide-awake municipality would ever enter into any contract that gave either the best end of it.

Characterizing them as "feeble bills" and "temporary expedients," Governor Roosevelt signed the Knight bill to amend the public service commission law in relation to holding companies and transactions between affiliated interests and public utility companies, and the Thayer bill in relation to the disclosure of identity of persons owning substantial interests in the voting capital stock of corporations under the jurisdiction of the commission.

China Promoting Power Development

The maintenance of small power plants by private individuals and the standardization of the equipment of all electric plants will be promoted and encouraged by the National Reconstruction Commission of the Chinese Government, it was stated recently by the chairman of the commission, Chang Ching-Kiang.

"Perhaps by far the major interest of the commission lies in the development of electrical enterprises throughout the country," Chairman Ching-Kiang said. "As a matter of fact, since the inauguration of the commission it has devoted itself more to the creation of electrical energy and its application in the daily life of the people than to any other undertaking.

"In the capital alone preparations are now under way for the construction of a power plant capable of generating 15,000 kw. It is also planned to meet the increasing demand of the farmers in the Wusih-Changchow region for electrical power for irrigation purposes by increasing the capacity of the power plant at Chehshuyen with the installation of another 3,200-kw. generator before the end of the current year.

"But while planning for the nationalization of electrical development, the commission is at the same time desirous of promoting and encouraging the maintenance of small power plants by private individuals, for it is obvious that the project for the electrification of the entire country would require a number of years for realization, and the more the public becomes interested in the enterprise the sooner will the plan be realized. What is held to be of importance by the commission is the necessity of standardizing the equipment of all private electricity plants to facilitate future co-operation.

"As a part of the program the commission has opened in Shanghai a modern electrical machinery factory to experiment with the manufacture of various electrical apparatus to meet the increasing demand for such. Up to now and for some time to come, however, electrical machinery will continue to be imported from abroad."

Measure to Reorganize Seattle Power Dept.

In keeping with suggestions made in a recent report of J. D. Ross, city lighting superintendent, Seattle, Wash., concerning reforms needed by his department, Councilman Otto A. Case has prepared a measure to give the municipal power and light organization jurisdiction over its own engineering work. Under present arrangements the city engineer has control of all such activities for all municipal divisions and enterprises.

Mr. Ross advised Mayor Frank Edwards and the city council, in connection with the efficiency survey for his department, that considerable time could be saved on the development program mapped out for city light and that various phases of the work could be better co-ordinated if his department had its own engineers. The Case measure is expected to divide the council and precipitate vigorous debate.

West Coast Makes Big Plans for N.E.L.A. Convention

Western leaders in the power industry are completing plans to make the 53d annual convention of the National Electric Light Association, to be held in San Francisco, Calif., June 16 to 20, one of the most memorable gatherings in the history of the organization.

Many of the outstanding figures in the American power world are coming from all parts of the United States to take part in the event. Noted captains of the industry and distinguished scientists in the field of electrical research will be in attendance to present reviews of the latest commercial and technical developments.

The general sessions of the convention will be held in the huge main hall of the Civic Auditorium. The large side halls will be devoted to the display

of important and interesting exhibits relating to the work of the various sections of the national association. The auditorium also will be the scene of brilliant entertainments and dance assemblies in the evenings.

San Francisco is preparing to blaze a welcome to the convention throng. Elaborate illumination of the downtown section, the Civic Center, Golden Gate Park, and the ocean beach is planned. Many impressive and beautiful displays are promised, providing a greeting to the visitors and a symbol of the industry they represent.

Boiler Inspectors to Hold Meeting, June 17-19

This year the annual meeting of the National Board of Boiler and Pressure Vessel Inspectors will be held at Chattanooga, Tenn. An interesting program is planned for the meeting, which opens on Tuesday morning, June 17, with an address of welcome by the Mayor of Chattanooga. Following this C. D. Thomas, chairman of the board, will make an address, and reports will be given by C. O. Myers and L. C. Peal, secretary-treasurer and statistician of the board, respectively. Sightseeing trips in and around Chattanooga are scheduled for the afternoon.

On Wednesday morning, June 18, a symposium will be held on welded and riveted boiler drums, which will be open for public discussion. In the afternoon delegates will visit boiler manufacturing plants in the vicinity. The annual banquet will be held in the evening. A business meeting in the morning and an executive session in the afternoon completes the program on Thursday, June 19.

Line to Link Louisville With Cincinnati

Construction of an electric transmission line 82 miles long and costing approximately $1,000,000 for interchange of power between Louisville and Cincinnati is provided in a contract which was signed recently by officials of the Louisville Gas & Electric Company and the Cincinnati Gas & Electric Company.

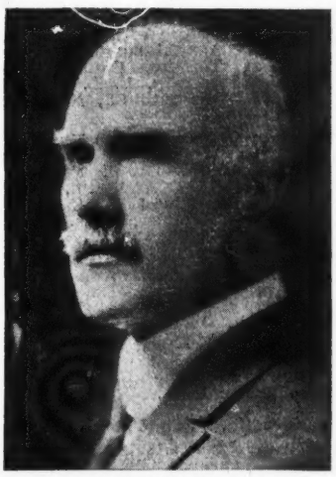
The route of the transmission line is from the Louisville company's Ohio Falls hydro-electric station, crossing the Ohio River and extending in a straight line to Madison, Ind., thence to Aurora, Ind., crossing the river back into Kentucky for a distance of five miles, crossing the river a third time to the Cincinnati company's new Columbia power station at the mouth of the Great Miami River in Ohio.

Plans for the interconnection call for a normal capacity of 40,000 kw., with electricity being transmitted at 132,000 volts. Most of the territory traversed by the proposed line is now being served with electric power and it is not planned to tap it for this purpose.

E. R. Fish, Chief Engineer of Boiler Insurance Co.

Edwards R. Fish, long a prominent authority on boiler design and construction, became associated on May 1 with the Hartford Steam Boiler Inspection and Insurance Company of Hartford, Conn., as chief engineer of its boiler division.

For some time Mr. Fish has been consultant to the boiler engineering department of the Combustion Engineering Corporation and previous to that was vice-president of the Heine Boiler Company. Before joining the Heine organization in 1893 Mr. Fish had been connected with the power plant department of the eneral Electric Company.



Edwards R. Fish

Long a member of the A.S.M.E. Boiler Code Committee, Mr. Fish is chairman of the sub-committee on unfired pressure vessels. He is also a member of the society's Power Test Code Committee and chairman of its sub-committee on boiler testing. He is a former president of the American Boiler Manufacturers Association, is now a director of the American Uniform Boiler-Law Society, and has served on the council of the A.S.M.E.

Seattle Plans Steam Plant

Determined to meet the challenge of future droughts, such as the one which caused a shortage in power output from hydro-electric plants last fall, city officials of Seattle, Wash., are considering plans whereby the municipal light and power system will be enlarged by the construction of a steam plant in the South End district. While no definite specifications have been adopted, the project calls for an initial investment of $200,000. Provisions for future expansion which would permit gradual enlargement of the plant to 200,000 or 250,000 hp. within the next eight or nine years will be made. The site under consideration is on the East Waterway in the tidelands district, near the new Skagit line terminal station.

News of Canada

Shawinigan plans new development—Abitibi may take over White Mud Falls—Three municipal plants in Saskatchewan to be sold

PLANS for a great new hydro-electric plant on the St. Maurice river, in the Province of Quebec, have been submitted by the Shawinigan Water & Power Company to the government. These plans are for the Rapide Blanc station, first of the new developments on the upper St. Maurice to be carried out by the Shawinigan company during the next few years. Work will be started on the Rapide Blanc site very soon. An installation of 160,000 hp. is provided for. It is estimated that the cost of this development will be $13,000,000. There will probably be six developments in all before the series is completed. The falls to be harnessed in the first development are located some 25 miles north of La Tuque, to which place the Shawinigan company last year ran a transmission line. Eventually this line, now carrying electric power northerly from Grand 'Mere, will become one of the highest voltage transmission lines in Canada. It is designed to carry 200,000 hp. at 250,000 volts.

IN THE EVENT that the British syndicate which has a priority permit for development of White Mud Falls, on the Nelson River, in the province of Manitoba, fails to exercise its option, which expires on May 21, it is likely the Abitibi Power & Paper Company will seek the privilege of developing this site, one of the most important in the province. So far, however, there has been no indication that the British interests intend relinquishing their claim. The Abitibi company, which has a controlling interest in the Manitoba Paper Company, is understood to be ready to go ahead with developments adjacent to White Mud Falls, and would find the water power available there necessary for its work.

IN THE Province of Saskatchewan no less than three municipal power plants are likely to be sold to outside interests in the near future. The city of Prince Albert has been offered $875,000 for its municipal electric plant and distributing system. The offer has been made by the Canadian Utilities, Ltd., which is prepared to spend a large sum of money in improving the plant. The Saskatchewan Power Commission has also made an offer which provides for adequate additions to the generating plant and distribution system as required to meet the demands of the city. The government-owned utility offers $300,000 for the power plant and $125,000 for the distribution system.

The city council of North Battleford has approved the final draft of a power agreement to turn over the municipal electric power station to the Saskat-

chewan Power Commission. By the agreement, the city will become an integral part in the provincial power scheme, but will retain ownership of the electrical distribution system for distributing steam from the power plant for heating purposes.

Three tenders have been received by the city of Swift Current for the municipal power plant. The tenders are from the Saskatchewan Power Commission, the Dominion Electric Company and the Montreal Engineering Company, the latter highest bidder at $390,000 for the complete plant and distributing system.

P. G. & E. Co. Merger Strikes Snag

H. H. Boomer and other creditors of Feather River Power Company, a subsidiary of Great Western Power Company of California, have filed a petition of intervention with the California Railroad Commission in opposition to the proposed merger of Pacific Gas & Electric Company, Great Western Power Company, San Joaquin Light & Power Corporation and Midland Counties Public Service Corporation. Complainants allege that there is a balance due them of approximately $783,000 on account of the construction of the Bucks Creek power project of the Feather River company, and that suits for the recovery of that amount have been instituted against the Great Western and Feather River companies, and that the proposed merger is not in the public interest or the interest of protestants.

The petitioners ask the railroad commission to require the liquidation of their claims from the funds involved in the purchase of the Feather River Power Company by the Great Western Power Company as agent and subsidiary of the Western Power Corporation. Most of the petitioners are sub-contractors who handled various parts of the construction of the Bucks Creek plant.

New Diesel Plant for Mesa

A large electric plant employing the latest type of Diesel engines is to be constructed in the vicinity of Mesa, Ariz., to produce and supply energy for a district of 36,400 acres, according to a petition for the organization of a new district which was filed recently with the Maricopa County Board of Supervisors.

The petition was filed by a committee from the Apache Trail Development Association, which is composed of land owners of the area which is seeking authority to form an electrical district. The organization and construction plans involve a bond issue of $364,000. The approximate cost of power delivered to land owners from the proposed plant is estimated by engineers engaged to study the plan at between 1¼ and 1½c. per kilowatt-hour.

COMING CONVENTIONS

American Society of Mechanical Engineers. Semi-Annual meeting at the Hotel Book-Cadillac, Detroit, Mich., June 9-12, 1930. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Boiler Manufacturers Association. Annual meeting at Skytop Lodge, Cresco, Pa., May 26-28. Secretary, A. C. Baker, 801 Rockefeller Bldg., Cleveland, Ohio.

American Institute of Electrical Engineers. Annual summer convention at Toronto, Canada, June 23-27. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Order of Steam Engineers. Annual convention and mechanical exhibit at the Grand Fraternity Building, 1626 Arch St., Philadelphia, Pa., June 9-12. Secretary, William S. Wetzler, 6033 Jefferson St., Philadelphia, Pa.

American Society of Heating & Ventilating Engineers. Annual summer meeting at the Curtis Hotel, Minneapolis, Minn., June 23-25. Secretary, A. V. Hutchinson, 33 West 39th St., New York City.

American Society for Testing Materials. Annual meeting at Haddon Hall, Atlantic City, N. J., June 23-27. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Refractories Institute. Annual spring meeting at The Greenbrier, White Sulphur Springs, W. Va., May 19-20. Secretary, Dorothy Texter, 2202 Oliver Bldg., Pittsburgh, Pa.

Association of Iron and Steel Electrical Engineers. Annual convention and iron and steel exposition at Broadway Auditorium, Buffalo, N. Y., June 16-20. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

Canadian Electrical Association. Annual Convention at the Manoir Richelieu via the S.S. "St. Lawrence," June 11-13, 1930. Secretary, H. M. Lyster, 405 Power Building, Montreal, Quebec.

National Association of Practical Refrigerating Engineers. Annual convention and exhibition at the Hotel Peabody, Memphis, Tenn., Nov. 11-14. Secretary, Edward H. Fox, 5707 West Lake St., Chicago, Ill.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting at Chattanooga, Tenn., June 17-19. Secretary, C. O. Myers, 14 Commercial National Bank Bldg., Columbus, Ohio.

National District Heating Association. Annual convention at the Coronado Hotel, St. Louis, Mo., June 3-6. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

National Oil and Gas Power Meeting, under auspices of A.S.M.E. Oil and Gas Power Division and Pennsylvania State College, will be held at State College, Pa., June 12-14. Chairman, L. H. Morrison, c/o *Power*, 10th Ave. and 36th St., New York City.

Second Plenary World Power Conference. Convenes at Berlin, German, June 16-25. Chairman of the American Committee, O. C. Merrill, Edmunds Building, Washington, D. C.

Universal Craftsmen Council of Engineers. Annual convention at the Hotel Kimball, Springfield, Mass., Aug. 5-8. Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

Personals

W. E. S. DYER, consulting engineer, of Philadelphia, Pa., left on the Europa April 26 for a business trip to Germany, Switzerland and France, representing the interests of several clients in connection with the design and construction of industrial power plants.

THOMAS Y. LOVERN, chief engineer of Columbus Electric & Power Company steam plant at Columbus, Ga., has resigned to accept a position as chief engineer of the Richmond, Va., plants of the American Tobacco Company. Mr. Lovern joined the staff of the Columbus company in 1919 as boiler room foreman. He was promoted to assistant chief engineer in 1925, and was advanced to chief engineer in 1927.

C. V. SMITH, connected with the Chase Company Division of the Kennecott Copper Corporation for the past twelve years, has recently opened an office in New York City as an independent consultant on industrial and metallurgical heating operations, furnaces and fuels.

S. MURRAY JONES, formerly associated with the Southeastern Engineering Company, is now connected with the engineering department of the Ohio Brass Company. Mr. Jones was at one time in the construction department of the Alabama Power Company.

JOSEPH C. GILBERT, who for the past two years has been employed by the United Engineers & Constructors as assistant superintendent and job engineer on the construction of steam power plants in Texas, is now hydraulic engineer for Winston & Company on the construction of the Cobble Mountain hydraulic-fill dam for the city of Springfield (Mass.) water-supply system.

THOMAS S. BURNS, who for the past seven years has been hydro-electric engineer with the Power Corporation of New York and the Northern New York Utilities, Inc., associated with W. P. Creager at Watertown, N. Y., until the absorption of these two power companies into the Niagara Hudson Power Corporation and the consequent disbanding of their engineering organizations, has been appointed senior hydro-electric engineer in the United States Engineer Office. Mr. Burns will be engaged in studies of water-power resources, markets for hydro-electric energy, combinations of navigation improvement and flood relief with hydro-electric power development in the Pittsburgh district.

W. B. KOCHENBERGER, formerly in charge of engineering and sales of the Lake Erie Engineering Corporation, Buffalo, was recently appointed chief engineer of the hydraulic machine department of R. D. Wood & Company.

Business Notes

BAILEY METER COMPANY, Cleveland, Ohio, announces that it has transferred its office in Chicago, Ill., to 20 North Wacker Drive Building. B. V. Knapp continues as branch manager in this territory, assisted by a staff of mechanical engineers specializing in metering control and combustion problems.

EASTERN STATES FUEL ENGINEERING CORPORATION, New York City, has been formed by Irwin R. Hoffman, formerly combustion engineer and district manager for the McClave-Brooks Company. The new company will engage in the sale of fuel and fuel-burning equipment for heating and small industrial plants.

ST. JOHN X-RAY SERVICE CORPORATION, New York City, has been organized by Ancel St. John, Ph.D., and Herbert R. Isenburger to carry on the X-ray inspection and sales business hitherto conducted by them. This includes the inspection of castings for high-pressure work.

THE D. CONNELLY BOILER COMPANY, Cleveland, Ohio, announces the establishment of New York offices at Room 912 Lincoln Building, 60 East 42nd St., New York City. J. G. Coutant is in charge as district manager of sales.

CHAIN BELT COMPANY, Milwaukee, Wis., has moved its New York office from 50 Church Street to new and larger quarters in the Chrysler Building, 405 Lexington Avenue.

RELIANCE ELECTRIC & ENGINEERING COMPANY, Cleveland, Ohio, announces the appointment of Ralph R. Newquist as sales engineer of its Chicago office.

SULLIVAN MACHINERY COMPANY, Chicago, Ill., announces that it has secured the sales rights for "Tanner-tanks" and "Tannergas" for the prevention of freezing in compressed air lines and at the exhaust of compressed air tools.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has appointed the Harry N. Crowder, Jr., Company of Easton, Pa., as its exclusive high-temperature cement dealer in Lehigh and Northampton counties of Pennsylvania and those portions of Warren and Hunterdon counties in New Jersey, adjacent to the Delaware River between the towns of Belvidere and Milford.

C. J. TAGLIABUE MANUFACTURING COMPANY, Brooklyn, N. Y., has acquired a new factory that will more than double its present facilities. Located at Park and Nostrand Avenues in Brooklyn, the new five-story building is a model of the latest industrial construction. It covers an area of 200 x 234 ft. and provides approximately 300,000 sq.ft. of working floor space. The company will occupy it about the first of July.

With the SOCIETY SECTIONS

A.S.M.E., Boston Section. Inspection trip through the turbine, deep-forging and main motor departments of the Lynn Works of the General Electric Company at 1:30 p.m. on May 23.

A.S.M.E., Metropolitan Section. Meeting in Room 501, Engineering Societies Building, on May 12 at 8 p.m. Subject: "Diesel Waste Heat Boilers for Marine and Other Uses," by Linn M. Rakestraw of the Foster Wheeler Corporation.

A.S.M.E., Ontario Section. Meeting at Peterborough, Ont., on May 8 at 3 p.m. Subject: "Water Powers," by R. O. Sweezey of the Beauharnois Power Company.

A.S.M.E., St. Joseph Valley Section. Inspection of Twin Branch Super-Power Plant at 4 p.m., May 8. Dinner meeting at 6:30 p.m. Subject: "The Character of Metals as Determined by X-ray Micro Photography," Prof. G. L. Clark, University of Illinois.

A.S.M.E., Washington (D. C.) Section. Joint Diesel engine meeting in the auditorium of the Interior Department Building at 8 p.m. on May 8. Subjects: "The Diesel Engine Situation Today," by Max Rotter, vice-president, Busch-Sulzer Bros. Diesel Engine Company; "Diesel Engines in Submarines," by E. Nibbs, chief engineer, Electric Boat Company; and "Light Weight Diesel Engines," by O. D. Treiber, president, Treiber Diesel Engine Company.

N.E.L.A., East Central Division. Annual convention at the Hotel Statler, Cleveland, Ohio, May 20-23. Secretary, D. L. Gaskill, Greenville, Ohio.

New England States Association of the National Association of Power Engineers. Annual convention and exhibition of power machinery at the State Armory, Salem, Mass., June 19-20, 1930. Secretary, E. S. Daniels, 113½ Bridge St., Salem, Mass.

New York State Association of the National Association of Power Engineers. Annual convention and exhibition of power machinery at the Niagara Hotel, Niagara Falls, N. Y., June 12-14. Chairman, Walter B. Smith, 482 Portage Road, Niagara Falls, N. Y.

Trade Catalogs

TANKS—A carefully compiled handbook on steel tanks for all purposes has just been issued by the Lancaster Iron Works, Inc., Lancaster, Pa. Contained in its 91 illustrated pages are specifications of standard sizes of tanks, fire protection and insurance requirements for the storage and use of volatile liquids, specifications of steels for various purposes, useful information and data in connection with design and installation.

REFRACTORIES — "Cutting Furnace Costs" is the title of a 40-page illustrated bulletin of the Plibrico Jointless Firebrick Company, 1844 Kingsbury St., Chicago, Ill., which completely describes the use of Plibrico furnace lining for monolithic furnace construction. A valuable feature is the ten-page section devoted to specifications for the installation of linings in the more common types of boilers. Simple instructions for determining the amount of material required for any job are also included.

PUMPS — An interesting description, profusely illustrated, of "Successful Canadian Pumping Stations" is contained in a 28-page bulletin recently published by the De Laval Steam Turbine Company, Trenton, N. J. Information on operating results obtained with gasoline-engine, steam-turbine, hydraulic-turbine and electrically driven pumps is included in this booklet. Large-scale sectional drawings show the improved features of design in the several classes of centrifugal pumps adapted for waterworks and industrial service.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.20 @ $2.30
Kanawha	Columbus	1.35 @ 1.50
Smokeless	Cincinnati	1.75 @ 2.25
Smokeless	Chicago	2.25
S. E. Kentucky	Chicago	1.35 @ 1.60
Steam	Pittsburgh	1.50 @ 1.60
Gas Slack	Pittsburgh	.90 @ 1.10
Big Seam	Birmingham	1.60 @ 1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.50
Barley	New York	1.40 @ 1.50

FUEL OIL

New York—May 1, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75@5.25c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c.@6.25c. per gal.

St. Louis—Apr. 23, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.495 per bbl., or 42 gal.; 26@28 deg., $1.595 per bbl.; 28@30 deg., $1.695 per bbl.; 30@32 deg., $1.745 per bbl.; 32@36 deg., gas oil, 4.276c. per gal.; 37@40 deg., distillate, 4.98c. per gal.

Pittsburgh—Apr. 15, f.o.b. local refinery, 30@34 deg., fuel oil, 4.37½c. per gal.; 36@40 deg., 4.37½@4.5c.

Philadelphia—Apr. 15, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati—Apr. 22, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Apr. 25, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 80c. per bbl.; 26@30 deg., 90c.@95c. per bbl.; 30@32 deg., $1.00@$1.05 per bbl.

Boston—Apr. 28, tank-car lots, f.o.b., 12@14 deg., Baumé, 3.5c. per gal.; 28@32 deg., 5.2c. per gal.

Da"as—Apr. 26, f.o.b. local refinery 26@30 deg., $1.25 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Los Angeles—Hollywood Medical-Dental Building Inc., awarded contract for the construction of a 12 story office building at Vine and Yucca Sts. to Boyle-Seely Construction Co., Edwards & Wildey Bldg. Estimated cost $1,000,000. Steam heating system, electric elevators, etc. will be installed.

Calif., Los Angeles—J. I. Phillips, 144 South Orange Dr., awarded contract for the construction of a 13 story apartment building at Wilshire Blvd. and Highland Ave. to J. V. McNeil Co., 5860 Avalon Blvd. Estimated cost $1,200,000.

Conn., Hartford—House of Good Shepard, 170 Sisson Ave., awarded contract for the construction of a home including industrial building, children's building, power house, etc. to Hayes Construction Co., 9 Court St., New Britain. Estimated cost $400,000.

Conn., Mansfield — State Bd. of Finance, Hartford, will receive bids until May 26, for the construction of a power plant, laundry, etc. at Mansfield Training Schools, here. Estimated cost $220,000. Towner & Sellew, 363 Main St., Middletown, are architects.

Conn., New Haven—United Illuminating Co., 128 Temple St., is receiving bids for extensions to power plant including 12,500 kw. generator, etc. Estimated cost to exceed $150,000. Westcott & Mapes, 139 Orange St., are architects.

Ill., Chicago—Granger & Bollenbacher, 333 North Michigan Ave., Archts., will receive bids until May 26, for a 5, 7 and 9 story medical and dental laboratory including steam heating and ventilation systems, etc. at 1849 West Polk St. for University of Illinois, Champaign. Estimated cost $1,500,000.

Kan., Garnett—City plans the construction of a power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., are engineers.

Mass., South Braintree (Br. Boston)—Norfolk Hospital, Norfolk County Comn., Dedham, is receiving bids for extension to boiler house here. Estimated cost to exceed $40,000. French & Hubbard, 210 South St., Boston, are architects.

Mich., Ypsilanti—State Administrative Board, G. R. Thompson, Budget Dir., Lansing, will receive bids until May 21 for the construction of a hospital including steam heating, ventilation and refrigeration systems, boilers, etc. Estimated cost $1,500,000. A. Kahn, 1000 Marquette Bldg., Detroit, is architect.

Minn., Little Falls — State of Minnesota, E. A. Walsh, Adjutant Gen., Court House, will receive bids until May 21, for the construction of waterworks and electric lighting systems at new Camp of Minnesota National Guard in Morrison county. Estimated cost $65,000. P. C. Bettenberg, 624 Merchants National Bank Bldg., St. Paul, is engineer.

Minn., St. Cloud — U. S. Veterans' Bureau, Construction Division, 764 Arlington Bldg., Washington, D. C., will soon award contract for the construction of a refrigeration plant at U. S. Veterans' hospital here.

Mo., Warsaw—Union Electric Light & Power Co., 12th and Locust Sts., St. Louis, awarded contract for clearing appoximately 7,000 acres of land in Bagnell dam reservoir area between Warsaw, Mo., and Branstotter bridge over Osage River to Wickliffe & West, Warsaw. Estimated cost $100,000. Stone & Webster Inc., 120 Broadway, New York, N. Y., are engineers.

N. Y., Dannemora—Dept. of Correction, State Office Bldg., Albany, received lowest bid for the construction of a power house at Clinton Prison here from J. McCawbley Co., 12 Margaret St., Plattsburg $128,917.

N. Y., Buffalo—The Great Atlantic & Pacific Tea Co., 420 Lexington Ave., New York, will receive bids about Aug. 1 for the construction of a cold storage plant here.

N. Y., New York—New York Central R.R. Co., 166 Lexington Ave., will receive bids late in July for the construction of a remote control substation at 338 Dyckman St. Estimated cost $100,000. F. B. Freeman is chief engineer.

O., Cleveland — Dept. of Welfare, A. T. Connar, Supt. of Public Works, Ninth and Oak Sts., Columbus, will soon award contract for a 1 story, 100 x 120 ft. laundry, cold storage plant, etc. at Hawthornden Farm, Cleveland State Hospital. Estimated cost $111,493. T. R. Ridley, Ohio-Hartman Bldg., Columbus, is architected.

O., Cleveland—Syndicate, c/o U. S. Building Corp., 720 Leader Bldg., is having plans prepared for the construction of a 10 story hotel, including steam heating system. Estimated cost $1,000,000.

Ore., Eugene—Eugene Water Board, is having plans prepared for the construction of an auxiliary steam power plant, 6,000 kw. capacity. It is expected that oil will be used for fuel, but arrangement of the boiler room will be such that hog fuel may be substituted. Estimated $400,000. Stevens & Koon, Spalding Bldg., Portland, are engineers.

Pa., Pittsburgh—City Ice & Fuel Co., 6611 Euclid Ave., Cleveland, O., awarded contract for footing and reinforced concrete for cold storage plant at Penn and Pike Sts. Estimated cost $2,500,000. Ball Ice Machine Co., 126 Chouto St., St. Louis, Mo., is engineer.

Texas—Associated Gas & Electric System, 61 Broadway, New York, acquired ice plant properties of Southern Ice & Utility Co. in Texas, Oklahoma, Arkansas and Louisiana and plans extensions and improvement to the various thirty plants.

Wash., Tacoma—City received lowest bid for the substructure of $2,000,000 steam electric plant on Hylebos Waterway from Wales Construction Co. $72,046.

Ont., Toronto—Bd. of Education, 155 College St., plans the installation of a new steam heating plant in Morse St. school. Estimated cost $27,000. C. E. Dyson is architect.

Ont., Toronto — Dept. of Public Works, Parliament Bldg., plans four additions to Royal Ontario Museum including steam heating system, etc., on Bloor St. Estimated cost $2,000,000. Architect not selected.

Que., Dollibeau — Lake St. John Power & Paper Co. Ltd., 522 Drummond Bldg., Montreal, is having plans prepared for the construction of a power plant, here. Estimated cost $1,000,000.

Equipment Wanted

Air Compressor—Washington, D. C.—D. C. Commissioners, will receive bids until May 16 for a portable gasoline driven air compressor.

Electrical Equipment—Seattle, Wash.—City will receive bids about May 15, for electrical equipment including thirteen 2,000 kw. transformers, two 600 amp., 20,000 v. oil circuit breakers, etc. to be installed in various substations of municipal light department.

Heaters, Exhaust Fans, etc.—Detroit, Mich.—Dept. of Water Supply, D. C., Grobbel, 735 Randolph St., will receive bids until May 21, for unit heaters fan heaters, exhaust fans, etc., for Springwells pumping plant and filter building. Estimated cost $100,000.

Pump—Duncan, Okla.—City is in the market for a 200 g.p.m. deep well turbine pump for waterworks.

Pump, etc.—Longview, Wash.—Washington Gas & Electric Co., will receive bids about May 28, for pump and auxiliary equipment in connection with waterworks. Estimated cost $200,000.

Pump and Motor, Transformers, etc.—Sudbury, Ont.—W. J. Ross, Clk., will soon receive bids for a 2,000 g.p.m. turbine pump and motor, transformers, etc. in connection with waterworks.

Pumping Equipment—Findlay, O.—Dept. of Public Service, O. J. Moorhead, Dir., will receive bids until May 23 for pumping equipment, etc., for proposed waterworks improvements.

Pumping Equipment—Rockford, Ill.—Sanitary District of Rockford, G. J. Boehland, Pres., Bd. of Trustees, will receive bids until May 27 for two 14 m.g.p.d. and 22 m.g.p.d. centrifugal pumping units, two hot water circulating pumping units two sump pumps, sludge pumping unit, switchboard, etc. for proposed sewage treatment plant.

Pumping Unit—Brownsville, Tex.—Cameron County Water Improvement Dist. 14, L. P. Stover, Pres., Merchants National Bank Bldg., will receive bids until May 27 for pumping unit, etc., in connection with proposed irrigation and water control improvements. Estimated cost $400,000.

Pumps—Niagara Falls, Ont.—Township of Stamford, plans the installation of one or two 600 g.p.m. centrifugal pumps in connection with waterworks. $15,000.

Pumps, Engine, Etc.—Louden, Tenn.—City will receive bids until May 21 for two 250 g.p.m. centrifugal pumps, 40 hp. low voltage high speed motor, 40 hp. Diesel engine, gas engine, etc. for proposed waterworks system.

Pumps and Motors—Dundee, Mich.—City, O. C. Spohr, Clk., will receive bids until May 15 for pumps and motors, etc., for proposed water purification and softening plant.

Transformers—London, Ont.—Public Utilities Commission, E. V. Buchanan, Gen. Mgr., plans to purchase two 1,500 kw. transformers.

Industrial Projects

Calif., South San Francisco—Pacific Bone, Coal & Fertilizer Co., Financial Center Bldg., San Francisco, awarded contract for the construction of a 2 story and 6 story manufacturing plant here to Barrett & Hilp, 918 Harrison St., San Francisco. Estimated cost $125,000.

Conn., New Haven—Crawford Oven Co., 200 Sheldon Ave., awarded contract for the construction of a 1 story, 90 x 200 ft. factory to Larkin Carey Co., 166 Brewery. Estimated cost $60,000.

Conn., Waterbury—Lux Clock Co., 97 Perry St., is receiving bids for the construction of a 4 story, 35 x 80 ft. factory. Estimated cost $75,000. T. M. Freney, 51 Leavenworth St., is architect.

Ill., Chicago—Illinois Steel Co., 208 South La Salle St., awarded contract for the construction of a 60 in. slabbing mill to Mesta Machine Co., West Homestead, Pa. Estimated cost $1,100,000.

Ill., East St. Louis—Philip Carey Co., Lockland, Cincinnati, O., is having preliminary plans prepared for the construction of a plant for the manufacture of aluminite insulating material, here. Estimated cost $500,000. T. A. Griffiths, c/o owner, is engineer.

Ind., Fort Wayne — Wayne Knitting Mills, awarded contract for the construction of a boiler plant to Indiana Engineering & Construction Co., 201-3 Central Bldg. Estimated cost $100,000.

Mass., Dorchester (br. Boston) — Albree Marble & Tile Co., Inc., 9 Ashland St., is having sketches made for the construction of a 1 story, 100 x 100 ft. factory. Estimated cost $50,000. W. P. Hatch, 60 State St., Boston, is architect.

Mass., Worcester—Melville Shoe Corp., 42 Hammond St., had plans prepared for addition to factory at Hammond and Tainter Sts. Estimated cost $50,000. G. E. Strohan, 33 West 42nd St., New York, N. Y., is architect.

Mich., Detroit — National Steel Corp., awarded contract for the construction of a mill to Mesta Machine Co., West Homestead, Pa. Estimated cost $1,500,000.

Mo., Crystal City — Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., awarded contract for foundation for a 325 x 50 x 100 ft. addition to glass plant, here. Estimated cost $1,000,000.

O., Cleveland — Union Steel Products Co., 13009 Athens Ave., had plans prepared for a 1 story, 60 x 100 ft. factory at Jenings Rd. and Jennings Ave. Estimated cost $40,000. W. H. Hatch, 562 Hippodrome Bldg., is architect.

Okla., Oklahoma City — Phillips Petroleum Co., Bartlesville, plans a second casinghead gasoline plant, here. Estimated cost $100,000. A. H. Riney, Bartlesville, is engineer.

Pa., Midland—Pittsburgh Crucible Steel Co., Oliver Bldg., Pittsburgh, awarded contract for the construction of a new blooming mill including electrical equipment to Mesta Machine Co., West Homestead. Estimated cost $700,000.

Pa., Philadelphia—Archibald Holmes & Son, Allegheny and K Sts., manufacturers of rugs, awarded contract for the construction of a 3 story, 96 x 305 and 49 x 60 ft. manufacturing plant at K St. and Erie Ave. to Cramp Co., Denckler Bldg. Estimated cost $400,000.

Pa., Pittsburgh — Jones & Laughlin Steel Co., Third and Ross Sts., will build a boiler plant at Second Ave. Estimated cost $100,000. D. L. Mekell, J. and L. Bldg., Third and Ross Sts., is company engineer. Work will be done by separate contracts.

Pa., Ridgway—Elliott Co., G. F. Elliott, Mgr., is having plans prepared for the construction of a 2 story, 140 x 160 ft. plant for the manufacture of dynamos, steam turbines, etc. Private plans. Work will be done by owner's forces.

Tex., McAllen—Corns China Co., Wellsville, O., is having preliminary plans prepared for the construction of a chinaware plant, here. Estimated cost $350,000.

Wis., West Allis — Allis-Chalmers Co., will soon award contract for a 1 story, 45 x 300 ft. factory on Greenfield St. Private plans.

Ont., Hamilton—B. H. and F. Prack, Pigott Bldg., Archts., are receiving bids for a 4 story addition to wire and screen plant for B. Greening Wire Co. Ltd., Queen St. N. Estimated cost $150,000.